DEPARTMENT OF THE AIR FORCE

FISCAL YEAR (FY) 2005 BUDGET ESTIMATES

RESEARCH, DEVELOPMENT, TEST AND EVALUATION (RDT&E)

DESCRIPTIVE SUMMARIES, VOLUME I

SCIENTIFIC AND TECHNOLOGY BUDGET ACTIVITIES 1-3

FEBRUARY 2004 (REVISED)



Fiscal Year 2005 Budget Estimates RDT&E Descriptive Summaries, Volume I Scientific and Technology Budget Activities 1 - 3 FEBRUARY 2004 (REVISED)

INTRODUCTION AND EXPLANATION OF CONTENTS

1. (U) GENERAL

- A. This document has been prepared to provide information on the United States Air Force (USAF) Research, Development, Test and Evaluation (RDT&E) program elements and projects in the FY 2005 President's Budget.
 - 1) All exhibits in this document have been assembled in accordance with DoD 7000.14R, Financial Management Regulation, Volume 2B, Chapter 5, Section 050402. Exception:
 - a) Exhibit R-1, RDT&E Program, which was distributed under a separate cover due to classification.
 - 2) Other comments on exhibit contents in this document:
 - a) Exhibits R-2/2a and R-3 provide narrative information for all RDT&E program elements and projects within the USAF FY 2005 RDT&E program with the exception of classified program elements. The formats and contents of this document are in accordance with the guidelines and requirements of the Congressional committees insofar as possible.
 - b) The "Other Program Funding Summary" portion of the R-2 includes, in addition to RDT&E funds, Procurement funds and quantities, Military Construction appropriation funds on specific development programs, Operations and Maintenance appropriation funds where they are essential to the development effort described, and where appropriate, Department of Energy (DOE) costs.
 - c) "Facilities Exhibits", Military Construction Project Data, (DD 1391), for improvements to and construction of government-owned facilities funded in RD&E, are included at the end of Volume III.

2. (U) CLASSIFICATION

A. All exhibits contained in Volumes I, II, and III are unclassified. Classified exhibits are not included in the submission due to the level of security classification and necessity of special security clearances.

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| MILSTAR LDR/MDR Sat Comm | 0604479F | 931 |
| Minimum Essential Emergency Communications Network (MEECN) | 0303131F | 1549 |
| Mission Planning Systems | 0208006F | 1519 |
| Modeling and Simulation Support | 0308601F | 1889 |
| Modular Control System | 0207412F | 1375 |
| MULTI-DISCIPLINARY ADV DEV SPACE TEC | 0603500F | 407 |
| | | |

| MULTI-DISCIPLINARY SPACE TECH | 0602500F | 165 |
|---|----------|------|
| Munitions Dispenser Development | 0604600F | 937 |
| National Polar-Orbiting Op Env Satellite | 0305178F | 487 |
| National Polar-Orbiting Operational Environmental Satellite System (NPOESS) | 0603434F | 549 |
| NATO Cooperative R&D | 0603790F | 579 |
| NAVSTAR Global Positioning System User Equipment Space | 0305164F | 1703 |
| NAVSTAR GPS (Space) | 0305165F | 1711 |
| NCMC - TW/AA System | 0305906F | 1833 |
| NEXT GENERATION BOMBER | 0604015F | 683 |
| Nuclear Weapons Support | 0604222F | 801 |
| NUDET Detection System (Space) | 0305913F | 1873 |
| Operationally Responsive Launch | 0604855F | 705 |
| OTHER PERSONNEL ACTIVITIES | 0808716F | 2037 |
| Physical Security Equipment | 0603287F | 519 |
| Physical Security Equipment | 0604287F | 897 |
| Polar MILSATCOM (Space) | 0603432F | 543 |
| Pollution Prevention | 0603859F | 669 |
| PREDATOR DEVELOPMENT/FIELDING | 0305219F | 1807 |
| Productivity, Reliability, Availability, Maintainability Program | 0708026F | 1997 |
| Ranch Hand II Epidemiology Study | 0605306F | 1139 |
| RAND Project Air Force | 0605101F | 1133 |
| RDT&E For Aging Aircraft | 0605011F | 1099 |
| REGION/ SECTOR OPERATIONS CONTROL CENTER | 0102326F | 1235 |
| Rocket Systems Launch Program (RSLP) | 0605860F | 1159 |
| | | |

| Satellite Control Network | 0305110F | 1655 |
|---|----------|------|
| Security And Investigative Activities | 0305128F | 1679 |
| Seek Eagle | 0207590F | 1475 |
| SERVICE-WIDE SUPPORT | 0901212F | 2043 |
| Shared Early Warning System | 0308699F | 1895 |
| Small Diameter Bomb | 0604329F | 903 |
| Space Architect | 0305917F | 1881 |
| Space Based Infrared Systems (SBIRS) High EMD | 0604441F | 925 |
| Space Control Technology | 0603438F | 557 |
| Space Technology 1 | 0602601F | 199 |
| Space Test Program | 0605864F | 1163 |
| SPACE WARFARE CENTER | 0305174F | 1719 |
| Space-Based Radar Dem/Val | 0603858F | 661 |
| Spacelift Range System | 0305182F | 1725 |
| SPACETRACK | 0305910F | 1841 |
| SPECIAL TACTICS/COMBAT CONTROL | 0408011F | 1957 |
| Specialized Undergraduate Pilot Training | 0604233F | 831 |
| STRAT WAR PLANNING SYS - USSTRATCOM | 0101313F | 1229 |
| Submunitions | 0604604F | 957 |
| Support Systems Development | 0708611F | 2005 |
| Tactical AIM Missiles | 0207161F | 1309 |
| Tactical Data Link Integration | 0604754F | 1033 |
| Test and Evaluation Support | 0605807F | 1153 |
| Theater Battle Management (TBM) C4I | 0207438F | 1399 |
| | | |

| Threat Simulator Development | 0604256F | 1115 |
|---|----------|------|
| Transformational SATCOM (TSAT) | 0603845F | 599 |
| Joint Unmanned Combat Air System (J-UCAS) | 0207256F | 717 |
| University Research Initiatives | 0601103F | 49 |
| Unmanned Air Vehicle Dev/Demo | 0603333F | 375 |
| Joint Unmanned Combat Air System (J-UCAS) | 0604731F | 991 |
| USAF Modeling and Simulation | 0207601F | 1481 |
| Warfighter Rapid Acquisition Program | 0203761F | 1241 |
| Wargaming and Simulation Centers | 0207605F | 1513 |
| WEATHER SERVICE | 0305111F | 1663 |
| Wideband MILSATCOM (Space) | 0603854F | 641 |
| WWMCCS/GLOBAL COMMAND & CONTROL SYSTEM | 0303150F | 1617 |

PROGRAM ELEMENT COMPARISON SUMMARY

| PROGRAM ELEMENT (By BUDGET A | ACTIVITY) | REMARKS |
|--------------------------------|--|---|
| BUDGET ACTIVITY #1: BASIC RESE | EARCH (Volume I) | |
| 0601102F | Defense Research Sciences | In FY 2005, Project 2311, Space Sciences changed its name to Space and Information Sciences. |
| 0601102F | | In FY 2005, Project 2304, Mathematical and Computer Services, efforts will be moved to the Project 2311, Space and Information Sciences. |
| | | In FY 2005, Project 2311, Space and Information Sciences, efforts were transferred from Project 2304, Mathematical and Computer Services. |
| BUDGET ACTIVITY #2: APPLIED RE | SEARCH (Volume I) | |
| None | | |
| BUDGET ACTIVITY #3: ADVANCED | TECHNOLOGY DEVELOPMENT (Volume I) | |
| 0603216F | Aerospace Propulsion and Power Technology | In FY 2005, Project 2480, Aerospace Fuels and Atmospheric Propulsion, efforts were transferred to Project 5098, Advanced Aerospace Propulsion. |
| | | In FY 2005, Project 4921, Aircraft Propulsion Subsystems Integration, efforts was transferred to Project 5098, Advanced Aerospace Propulsion. |
| | | In FY 2005, Project 5098, Advanced Aerospace Propulsion, efforts were transferred from Project 2480, Aerospace Fuels and Atmospheric Propulsion. |
| | | In FY 2005, Project 5098, Advanced Aerospace Propulsion, efforts were transferred from Project 4921, Aircraft Aerospace Propulsion. |
| BUDGET ACTIVITY #4: ADVANCED | COMPONENT DEVELOPMENT & PROTOTYPE (Volume 2) | |
| 0603434F | National Polar-Orbiting Operations Environmental Satellite System (NPOESS) | In FY 2005, Project 4056, NPOESS, efforts were transferred to PE 0305178F, NPOESS, Project 4056, NPOESS, in order to accomplish program System Development & Demonstration. |
| 0603791F | International Space Cooperative R&D | In FY 2005, Project 5035, International Space Cooperative R&D, includes new start efforts. |
| 0603850F | Integrated Broadcast System (IBS) | In FY 2005, Project 4778, IBS, efforts were transferred to PE 0207443F, Family of Interoperable Operational Picture (FIOP), Project 5137, FIOP. |
| 0604015F | Next Generation Bomber | In FY 2005, this is a new PE. |
| BUDGET ACTIVITY #5: SYSTEM DE | VELOPMENT & DEMONSTRATION (SDD) (Volume 2) | |

 0207256F
 Joint-Unmanned Combat Air System (JUCAS)
 In FY05, the PE was renamed Joint-Unmanned Combat Air System (JUCAS).

 0207434F
 Link 16 Support & Sustainment
 In FY 2005, Project 5051, FIOP, efforts were transferred to PE 0207443F, FIOP, in order to consolidate FIOP funding.

| 0207443F | Family of Interoperable Operational Picture (FIOP) | In FY 2005, this is a new PE. |
|----------|--|---|
| | | In FY 2005, efforts from PE 0604754F, Tactical Data Links Integration, Project 5051, FIOP, efforts were transferred to Project 5137, FIOP, in order to consolidate FIOP program funding. |
| | | In FY 2005, efforts from PE 0207438F, Theater Battle Management C4I, Project 4790, Theater Battle Management Core System (TBMCS), were transferred to Project 5137, FIOP, in order to consolidate FIOP program funding. |
| | | In FY 2005, efforts from PE 0603580F, Integrated Broadcast Service (IBS) (Dem/Val), Project 4781, IBS, efforts were transferred to Project 5137, FIOP, in order to consolidate FIOP program funding. |
| | | In FY 2005, efforts from PE 0604754F, Tactical Data Links Integration, Project 654992, FIOP; were transferred to Project 5137, FIOP, in order to consolidate FIOP program funding. |
| | | In FY 2005, efforts from PE 0207438F, Theater Battle Management C4I, Project 4790, TBMCS, were transferred to Project 5137, FIOP, in order to consolidate FIOP program funding. |
| | | In FY 2005, efforts from PE 0603850F, IBS (Dem/Val), Project 4778, IBS, were transferred to Project 5137, FIOP, in order to consolidate FIOP program funding. |
| 0207450F | Multi-Sensor Command and Control Aircraft (MC2A) | In FY 2005, this is a new PE. |
| | | In FY 2005, PE 0207449F, C2C, Project 5064, Airframe, efforts were transferred to Project, 5131, M2CA Airframe. |
| | | In FY 2005, PE 0207449F, C2C, Project 5065, Sensors, efforts were transferred to Project 5132, MC2A Sensors. |
| 0305178F | NPOESS | In FY2005, this is a new PE. |
| | | In FY2005, Project 4056, NPOESS, efforts were transferred from PE 0603434F, NPOESS, Project 4056, NPOESS, in order to accomplish System Development and Demonstration. |
| 0604221F | Counterspace Systems | In FY 2005, Project A001, Counter Satellite Communications Systems, includes new start efforts. |
| 0604226F | B-1B | In FY 2005, Project 4596, Conventional Mission Upgrade, includes new start efforts. |
| 0604270F | Electronic Warfare (EW) Development | In FY 2005, Project 8462, Airborne Electronic Attack, includes new start efforts. |
| 0604754F | Tactical Data Link Integration | In FY 2005, Project 4992, FIOP, efforts transferred to PE 0207443F, Family of Interoperable Operational Pictures (FIOP), Project 655137, FIOP in order to consolidate FIOP funding. |

| | 0604617F | Agile Combat Support | In FY 2005, Project 2895, Civil Engineering Readiness (CE), includes new start efforts. |
|------------|--------------------------|---|--|
| | 0604731F | Joint-Unmanned Combat Air System (JUCAS) | In FY 2005, Project 5058, J-UCAS, efforts were transferred to a new RDT&E Defense-wide Program Element. |
| BUDGET ACT | TIVITY #6: RDT&E MANAGEN | IENT SUPPORT (Volume 2) | |
| | 0305116F | Aerial Targets | In FY 2005, this is a new PE. |
| | | | In FY 2005, Projects 5136, Target Systems Development, efforts were transferred from PE 0604735F, Combat Training Ranges, Project 2286, Combat Training Range Equipment. |
| | 0604759F | Major T&E Investment | In FY 2005, Project 4597, Air Force Test Investments, includes a new start effort |
| | 0702806F | Acquisition and Management Support | In FY05, this is a new PE. |
| BUDGET ACT | TIVITY #7: OPERATIONAL S | STEM DEVELOPMENT (Volume 3) | |
| | 0101113F | B-52 Squadrons | In FY 2005, Project 5039, B-52 Modernization, includes new start efforts. |
| | 0207028F | Joint Expeditionary Force Experiment (JEFX) | In FY 2005, Project 4373, JEFX, efforts were transferred to PE 0207449F, C2C, Project 5140, JEFX. |
| | | | FY 2005, Project 4991, JDEP, efforts were transferred to PE 0207601F, USAF Modeling & Simulation, Project 5133, Joint Distribute Engineering Plant (JDEP). |
| | 0207141F | F-117A Squadrons | In FY 2005, Project 3956, F-117A Squadrons, includes new start efforts. |
| | 0207161F | Tactical AIM Missiles | In FY 2005, Project 4132, AIM-9 Product Improvement, includes new start efforts. |
| | 0207224F | Combat Rescue and Recovery | In FY 2005, this is a new PE. |
| | 0207438F | Theater Battle Management C4I | In FY 2005, Project 4790, TBMCS, efforts were transferred to PE 0207443F, FIOP, Project 5137, FIOP, in order to consolidate FIOP funding. |
| | 0207449F | Command and Control Constellation (C2C) | In FY 2005, this Program Element (PE) was renamed Command and Control Constellation (C2C). |
| | | | In FY 2005, Project 5078, Horizontal Integration, efforts were transferred from Project 5064, Airframe. |
| | | | In 2005, Project 5064, JEFX, efforts were transferred from PE 0207028F, Joint Expeditionary Force Experiment, Project 5140, JEFX. |
| | | | In FY 2005, Project 5064, Airframe, efforts were transferred to PE 0207450F, MC2A, Project |

In FY 2005, Project 5064, Airframe, efforts were transferred to PE 0207450F, MC2A, Project 655131, MC2A Airframe.

In FY 2005, Project 5065, Sensors, efforts were transferred to PE 0207450F, MC2A, Project 655132, MC2A Sensors.

In FY 2005, Project 5078, Horizontal Integration, efforts were transferred from Project 675064, Airframe.

In 2005, Projects 5140, JEFX, efforts were transferred from PE 0207028F, Joint Expeditionary Force Experiment, Project 674373, JEFX.

In FY 2005, Project Number 5135, Distributed Mission Operations (DMO), includes new start efforts.

In FY05, Project 4567, was renamed to the Joint Synthetic Battlespace (JSB) Environment.

In FY 2005, Project 4567, JSB, efforts were transferred from Project 5005, Executive Agent for Air Space Environment.

In FY 2005, Projects 4991, JDEP, efforts were transferred from PE 0207028F, Joint Expeditionary Force Experiment, Project 674991, JDEP.

In FY 2005, Project 5005, Executive Agent for Air Space Environment, efforts transferred to Project 4567, JSB Environment.

0207601F

USAF Modeling & Simulation

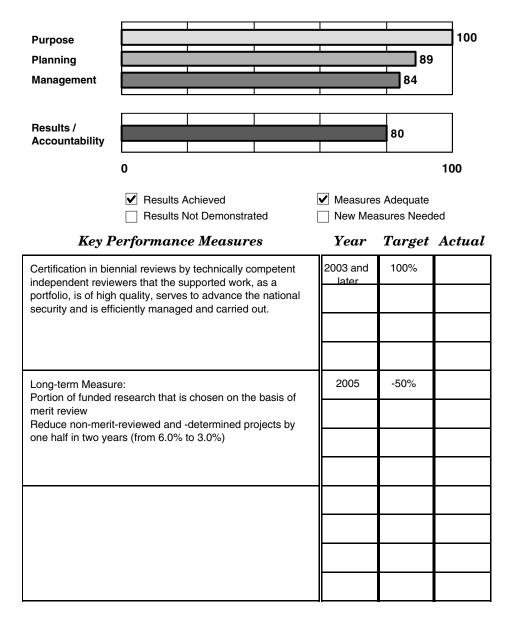
| 0303140F | Information Systems Security Program | In FY 2005, Project 4579, Information Warfare, was terminated. |
|----------|---|--|
| | | In FY 2005, Project 4871, Information Operations Technology, efforts were transferred to PE 0305193F, Intelligence Support to Information Operations, Project 4871, Information Operations Technology. |
| | | In FY 2005, Projects 4871, Information Operations Technology, efforts were transferred to PE 0305887F, Intelligence Support to Information Warfare, Project IOT, Information Warfare Support. |
| 0305193F | Intelligence Support to Information Operations | In FY 2005, this is a new PE. |
| | | In FY 2005, Project 4871, Information Operations Technology, efforts were transferred from PE 0303140F, Information Systems Security Program, Project 4871, Information Operations Technology. |
| 0305219F | Predator Development/Fielding | In FY2005, this is a new PE. |
| | | In FY2005, Project 5143, Predator, efforts were transferred from PE 0305205F, Endurance Unmanned Aerial Vehicles, Project 4755, Predator |
| 0305220F | Global Hawk Development/Fielding | In FY 2005, this is a new PE. |
| | | In FY 2005, Project 5144, Global Hawk, efforts were transferred from PE 305205F, Endurance Unmanned Aerial Vehicles, Project 4799, Global Hawk. |
| 0305887F | Electronic Combat Intelligence Support | In FY 2005, this is a new PE. |
| | | In FY 2005, Project IOT, Information Operations Technology, efforts were transferred from PE 0303140F, Information Systems Security Program, Project 4871, Information Operations Technology. |
| 0401130F | C-17 Aircraft | In FY 2005, Project 4886, C-17 Aircraft, efforts were transferred to PE 41134F, Large Aircraft Infra- Red Countermeasures (LAIRCM), Project 4942, LAIRCM. |
| 0401134F | Large Aircraft Infra-Red Countermeasures (LAIRCM) | In FY 2005, Project 4942, LAIRCM, efforts were transferred from PE 0401130F, C-17 Aircraft, Project 4886, C-17 Aircraft. |
| 0408011F | Special Tactics/Combat Control | In FY 2005, this is a new PE. |
| 0808716F | Other Personnel Activities | In FY 2005, this is a new PE. |

The following are Program Elements not providing RDT&E exhibits due to classification:

- 0101815F Advanced Strategic Programs
- 0207248F Special Evaluation Program
- 0207424F Evaluation and Analysis Program
- 0207591F Advanced Program Evaluation
- 0208160F Technical Evaluation System
- 0208161F Special Evaluation System
- 0304311F Selected Activities
- 0603801F Special Programs

Program: Basic Research

Agency: Department of Defense--Military Bureau: Research, Development, Test, and Evaluation



*Rating: Effective

Program Type Research and Development

Program Summary:

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

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

1. The grants/contract solicitation, review and award processes are competitive. 2. The program is reviewed regularly by technically capable outside reviewers, which recommend improvements they would like to be implemented. They indicate that the work is of overall high quality.

3. The program has competent planning and management.

4. Earmarking of projects in the program has increased in the past decade and contribute less than the typical research project to meeting the agency's mission.

In response to these findings, the Administration will:

1. Continue to emphasize the use of independent review panels in assessing the performance of the program.

2. Work with the research community and Congress to explain the need to limit claims on research grant funds to proposals that independently can meet the standards of a strict merit-review process.

Program Funding Level (in millions of dollars)

* This assessments has not changed since publication in the FY 2004 Budget. For updated program funding levels, see Data File - Funding, Scores, and Ratings.

PE NUMBER: 0601102F PE TITLE: Defense Research Sciences

| | Exhib | it R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 |
|--|--------------------------------------|-------------|----------|-------------|-----------|----------|----------|----------|----------|-------|
| BUDGET ACTIVITY PE NUMBER AND TITLE 01 Basic Research 0601102F Defense Research Sciences | | | | | | | | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ III WIIIIOIIS) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| | Total Program Element (PE) Cost | 211.559 | 212.897 | 217.304 | 230.536 | 256.246 | 245.626 | 248.537 | 0.000 | 0.00 |
| 2301 | Physics | 23.487 | 25.749 | 23.690 | 23.904 | 27.774 | 24.828 | 25.199 | 0.000 | 0.00 |
| 2302 | Solid Mechanics and Structures | 11.236 | 11.641 | 13.276 | 14.873 | 16.594 | 17.314 | 18.535 | 0.000 | 0.00 |
| 2303 | Chemistry | 27.987 | 27.939 | 29.292 | 28.531 | 31.485 | 28.218 | 28.698 | 0.000 | 0.00 |
| 2304 | Mathematical and Computer Sciences | 31.286 | 29.293 | 25.663 | 34.397 | 39.314 | 35.952 | 32.022 | 0.000 | 0.000 |
| 2305 | Electronics | 23.234 | 25.041 | 25.174 | 26.833 | 29.722 | 29.674 | 30.117 | 0.000 | 0.00 |
| 2306 | Materials | 14.170 | 15.035 | 15.917 | 15.971 | 17.704 | 17.538 | 17.871 | 0.000 | 0.00 |
| 2307 | Fluid Mechanics | 10.025 | 12.875 | 10.902 | 10.997 | 11.715 | 11.426 | 11.630 | 0.000 | 0.00 |
| 2308 | Propulsion | 22.554 | 15.660 | 15.864 | 16.918 | 17.791 | 17.675 | 18.053 | 0.000 | 0.000 |
| 2311 | Space and Information Sciences | 14.681 | 20.379 | 24.661 | 23.286 | 22.523 | 22.868 | 23.660 | 0.000 | 0.000 |
| 2312 | Biological Sciences | 13.605 | 9.272 | 9.631 | 9.756 | 13.443 | 10.279 | 10.526 | 0.000 | 0.000 |
| 2313 | Human Performance | 12.332 | 12.667 | 13.596 | 13.655 | 14.412 | 14.105 | 14.319 | 0.000 | 0.000 |
| 4113 | External Research Programs Interface | 6.962 | 7.346 | 9.638 | 11.415 | 13.769 | 15.749 | 17.907 | 0.000 | 0.000 |

Note: In FY 2005, Project 2311, "Space Sciences," changed its name to "Space and Information Sciences."

(U) A. Mission Description and Budget Item Justification

This program consists of extramural research activities in academia and industry along with in-house investigations performed in the Air Force Research Laboratory. This program funds fundamental broad-based scientific and engineering research in areas critical to Air Force weapon systems. Projects are coordinated through the Defense Reliance process to harmonize efforts, eliminate duplication, and ensure the most effective use of funds across the Department of Defense. All research areas are subject to long-range planning and technical review by both Air Force and tri-Service scientific planning groups. Note: In FY 2004, Congress added \$1.0 million for Advanced Adaptive Optics, \$1.7 million for National Fotonics Research, \$0.5 million for Non-lethal Stunning/Immobilizing Weapons Research, \$1.0 million for Corrosion Protection of Aluminum Alloys Used in Aircraft, \$1.4 million for Thin Film Magnetic Materials, \$2.0 million for the National Hypersonic Research Center, \$2.55 million for Coal-Based Jet Fuel, \$2.0 million for the Chabot Space and Science Center, \$1.1 million for Quantum Information Technology, and \$1.8 million for Information Security and Cyber Counter Terrorism.

| Exhibit R-2, RDT&E | DATE Februa | ary 2004 | | | | |
|---|---|----------------|----------------|--|--|--|
| JDGET ACTIVITY 1 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | | | | | |
| J) <u>B. Program Change Summary (\$ in Millions)</u> | | | | | | |
| | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | | | |
| J) Previous President's Budget | 217.863 | 204.754 | 218.188 | | | |
| U) Current PBR/President's Budget | 211.559 | 212.897 | 217.304 | | | |
|) Total Adjustments | -6.304 | 8.143 | | | | |
|) Congressional Program Reductions | | -5.080 | | | | |
| Congressional Rescissions | | -1.827 | | | | |
| Congressional Increases | | 15.050 | | | | |
| Reprogrammings | -0.076 | | | | | |
| SBIR/STTR Transfer | -6.228 | | | | | |
| <u>Significant Program Changes:</u> Changes to this program since the previous President's Budget | | | | | | |
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R-1 Shopping List - Item No. 1-2 of 1-48

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justif | ication | | | | DATE | February | 2004 |
|-----|---|--|---|--|---|--|---|--|------------------------------------|---|-------------------------|
| | GET ACTIVITY asic Research | | | 0 | YE NUMBER AND 1601102F Defe Sciences | | :h | PROJECT 2301 Pł | | ER AND TITLE | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 20 | 009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estim | | Complete | |
| 230 | | 23.487 | 25.749 | 23.690 | 23.904 | 27.774 | 24.828 | 2 | 5.199 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | |
| (U) | A. Mission Description and Budget Item Physics basic research aims to revolutioni optics, electro-energetics, and communica avionics, and microwaves and to improve improvements in electromagnetic countern and optical physics; electro-energetics (interactions) physics. | ze advances in a tions to allow s technologies as measures, comr | uperior strateg sociated with nunications, sn | ic awareness. ' non-intrusive/n nall satellites, a | The goals are to on-destructive and novel senso | o enable and en testing and ana rs. The primar | hance technolo lysis. Researc y areas of rese | ogies criti h topics f arch inve | ical to A focus or estigated | Air Force lasers n revolutionary 1 by this projec | s, optics, |
| (U) | B. Accomplishments/Planned Program (MAJOR THRUST: Investigate regulated, adaptive optics. | | , variable-ener | gy lasers, laser | arrays, and mu | lti-aperture | <u>F</u> Y | <u>7 2003</u> 8.785 | | <u>FY 2004</u> 9.987 | <u>FY 2005</u> 8.223 |
| (U) | In FY 2003: Studied combining high powe Investigated concepts to achieve laser high large, lightweight adaptive optics and large imaging applications. Studied laser micro- multi-functional micro- and nano-satellites | output powers aperture telesc machining tech | at wavelengths opes for very h | s required for sp nigh-resolution | pace application space surveilla | ns. Explored nce and | | | | | |
| (U) | In FY 2004: Expand studies of high power support large-core, single-mode fibers. Inv lasers to achieve power levels needed for m wavelengths of high-power laser arrays to studies of large, lightweight adaptive optics and imaging applications. Extend studies of imaging. Study new optical techniques to a Study laser micro-machining techniques fo micro- and nano-satellites. In FY 2005: Continue investigating physic wavelength band lasers (e.g., solid state, fra- tied to large, multi-aperture, adaptive teleso | vestigate direct a nultiple directed values needed for s and large aper of large aperture achieve very lar r producing spe cal properties of ee electron, fibe copes and radars | and nonlinear of energy applic or space applic ture telescopes adaptive teles ge aperture, ve cialized micro lasers to enable r). Investigate s. Expand stud | pptical methods ations. Continu- cations and airc for very high- copes for very ery wide-band p - and nano-con le, monitor, and novel tomogra lies of novel las | s for combining ue research to c raft protection. resolution space high-resolution phased array rac apponents for mu d regulate tunab aphic and optica ser micro-and n | beams of fiber onvert Expand e surveillance deep space dars in space. alti-functional ole, wide al techniques ano-machining | | | | | |
| Pro | ect 2301 | | R-1 S | hopping List - Ite | m No. 1-3 of 1-48 | 3 | | | | Exhibit R-2a (F | PE 0601102F) |

| BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND T 01 Basic Research 2301 Physics applications for infrared countermeasures. (U) (U) MAJOR THRUST: Explore high-energy electro-energetic devices, communication systems, surveillance and countermeasure platforms, and aerodynamic systems to facilitate creation of better propellants and more capable directed energy weapons. Note: In FY 2005, these activities will be moved to the "atoms, molecules, and particles" efforts in this Project. 8.133 8.012 (U) In FY 2003: Researched plasma physics to investigate fundamental interactions between charged particles and electromagnetic fields for future directed energy weapons, affordable low-observables, and space communications and surveillance. Explored physics governing dynamic molecular interactions in combustion and high energy density propellants. Examined the detailed physics of material, surface, and air breakdown in the presence of strong electric fields. 9 (U) In FY 2004: Enhance research studies in plasma physics to investigate fundamental interactions between charged particles and electromagnetic fields for all-electric military platforms, high-bandwidth communications, advanced long-distance covert surveillance, and sipe ecommunications and surveillance. Expand research into the physics of molecular interactions in combustion and high energy density propellants. Continue examining the detailed physics of material, surface, and air breakdown in the presence of strong electric fields to facilitate creation of more compact, lighter weight, portable pulsed power systems in order to power future directed energy weapons. Expand the | 1 F |
|---|------------------|
| (U) (U) MAJOR THRUST: Explore high-energy electro-energetic devices, communication systems, surveillance and 8.133 8.012 countermeasure platforms, and aerodynamic systems to facilitate creation of better propellants and more capable directed energy weapons. Note: In FY 2005, these activities will be moved to the "atoms, molecules, and particles" efforts in this Project. (U) In FY 2003: Researched plasma physics to investigate fundamental interactions between charged particles and electromagnetic fields for future directed energy weapons, affordable low-observables, and space communications and surveillance. Explored physics governing dynamic molecular interactions in combustion and high energy density propellants. Examined the detailed physics of material, surface, and air breakdown in the presence of strong electric fields. (U) In FY 2004: Enhance research studies in plasma physics to investigate fundamental interactions between charged particles and electromagnetic fields for all-electric military platforms, high-bandwidth communications, advanced long-distance covert surveillance, and space communications and surveillance. Expand research into the physics of molecular interactions in combustion and high energy density propellants. Continue examining the detailed physics of material, surface, and air breakdown in the presence of strong electric fields to facilitate creation of more compact, | |
| (U) MAJOR THRUST: Explore high-energy electro-energetic devices, communication systems, surveillance and 8.133 8.012 countermeasure platforms, and aerodynamic systems to facilitate creation of better propellants and more capable directed energy weapons. Note: In FY 2005, these activities will be moved to the "atoms, molecules, and particles" efforts in this Project. (U) In FY 2003: Researched plasma physics to investigate fundamental interactions between charged particles and electromagnetic fields for future directed energy weapons, affordable low-observables, and space communications and surveillance. Explored physics governing dynamic molecular interactions in combustion and high energy density propellants. Examined the detailed physics of material, surface, and air breakdown in the presence of strong electric fields. (U) In FY 2004: Enhance research studies in plasma physics to investigate fundamental interactions between charged particles of molecular interactions and surveillance. Explored physics for all-electric military platforms, high-bandwidth communications, advanced long-distance covert surveillance, and space communications and surveillance. Expand research into the physics of molecular interactions in combustion and high energy density propellants. Continue examining the detailed physics of material, surface, and air breakdown in the presence of strong electric fields to facilitate creation of more compact, | |
| electromagnetic fields for future directed energy weapons, affordable low-observables, and space communications and surveillance. Explored physics governing dynamic molecular interactions in combustion and high energy density propellants. Examined the detailed physics of material, surface, and air breakdown in the presence of strong electric fields. (U) In FY 2004: Enhance research studies in plasma physics to investigate fundamental interactions between charged particles and electromagnetic fields for all-electric military platforms, high-bandwidth communications, advanced long-distance covert surveillance, and space communications and surveillance. Expand research into the physics of molecular interactions in combustion and high energy density propellants. Continue examining the detailed physics of material, surface, and air breakdown in the presence of strong electric fields to facilitate creation of more compact, | 0.000 |
| particles and electromagnetic fields for all-electric military platforms, high-bandwidth communications, advanced long-distance covert surveillance, and space communications and surveillance. Expand research into the physics of molecular interactions in combustion and high energy density propellants. Continue examining the detailed physics of material, surface, and air breakdown in the presence of strong electric fields to facilitate creation of more compact, | |
| understanding of short-pulse intense electric fields' effects on cells and organelles. | |
| (U) In FY 2005: Not Applicable. Note: In FY 2005, these activities will be moved to the "atoms, molecules, and particles" efforts in this Project. | |
| (U) | |
| (U) MAJOR THRUST: Manipulate atomic and molecular properties, atomic collision processes, and atomic, molecular, 4.646 1.295 ionic, and radiation interactions to improve explosives and fuels, advance directed energy systems, enhance surveillance, provide superior communications, and improve precision navigation. 1.295 | 11.422 |
| (U) In FY 2003: Investigated fundamental interplay between atoms and strong electromagnetic fields to identify potentially new classes of lasers. Completed isomeric, high energy density storage for flash radiation devices to diminish or eliminate refueling requirements on long endurance flights. Furthered research of holographic films for correction of distortion and aberration in space surveillance telescopes. Commenced measuring ultraviolet emission cross sections from electron impact to provide fundamental data needed in satellite surveillance. | |
| (U) In FY 2004: Expand investigations into the fundamental interplay between atoms and strong electromagnetic fields to identify potentially new classes of lasers. Continue measuring ultraviolet emission cross sections from electron impact. Explore uses for laser-cooled and trapped atoms. Note: In FY 2004, flash radiation efforts were transferred to another DoD agency. | |
| (U) In FY 2005: Continue to characterize interactions of atoms and molecules in strong electromagnetic fields for laser | |
| Project 2301 R-1 Shopping List - Item No. 1-4 of 1-48 Exhibit F | 2a (PE 0601102F) |

| Exhibit R-2a, RDT& | DA | DATE February 2004 | | | |
|---|---|-----------------------|-----------------|--------------|--|
| BUDGET ACTIVITY 01 Basic Research | PROJECT NUMBER AND TITLE 2301 Physics | | | | |
| applications. Examine techniques for precision measurement of at processes, and fundamental interactions between atoms, molecules high-resolution spectroscopy via the trapping and cooling of atoms interactions in combustion and high energy density propellants. Co breakdown in the presence of strong electric and sub-meter wave f of all-electric military platforms, high-bandwidth communications. Continue probing the effects of short-pulse intense electric fields o "high-energy electro-energetics" efforts described earlier in this Pr (U) | , ions, and radiation. Explore advances in and ions. Continue exploring dynamic molecular ontinue examining materials, surfaces, and air ields. Continue plasma physics studies in the areas , and advanced long-distance covert surveillance. n cells and organelles. Note: In FY 2005, the oject were moved to this activity. | 0.000 | 2.001 | 1015 | |
| (U) MAJOR THRUST: Advance technologies for space sensors, imag effective space situational awareness. | ing, identification, and tracking methods, and | 0.000 | 3.281 | 4.045 | |
| (U) In FY 2003: Not Applicable. | | | | | |
| (U) In FY 2004: Conduct research on the interaction of systems and see Develop models to predict the atmospheric effects on laser propagations sensor performance to incorporate measurements of terrestrial and methods of using holographic techniques for dynamic correction of telescopes. Study methods to enhance hyperspectral imagery using Note: Highlighted focus area beginning in FY 2004. (U) In FY 2005: Probe effects of atmospheric and space environments propagation. Identify, characterize, and model parameters enabling of objects in and from space. Evaluate tools and enhance system in the space environment of the space | ation. Investigate means to expand models of space backgrounds and radiation. Examine f distortion and aberration in space surveillance g polarization and hypertemporal information. on sensors and energy (i.e., information) g remote sensing, locating, and precision tracking | | | | |
| awareness. | | | | | |
| (U) | | 1.022 | 0.002 | 0.000 | |
| (U) CONGRESSIONAL ADD: Center for Astronomical Active Optic (U) In FY 2003: Expanded research studies on adaptive optics to furth projection into space, space reconnaissance, space power collector | er enable adaptive telescopes for laser beam | 1.923 | 0.992 | 0.000 | |
| (U) In FY 2004: Study optional methods and techniques that may be u adaptive optic accomplishments. | • | | | | |
| (U) In FY 2005: Not Applicable. | | | | | |
| (U) | | | | | |
| (U) CONGRESSIONAL ADD: National Fotonics Research Center. | | 0.000 | 1.686 | 0.000 | |
| (U) In FY 2003: Not Applicable. | | | | | |
| (U) In FY 2004: Support fundamental research at the National Fotonic | es Research Center. | | | | |
| (U) In FY 2005: Not Applicable. | | | | | |
| Project 2301 | R-1 Shopping List - Item No. 1-5 of 1-48 | | Exhibit R-2a (F | PE 0601102F) | |

| Exhibit R-2a, RDT&E Project Justification | | | | | | | DATE February 2004 | | | |
|---|---------------------------------|---------------------|-----------------------------------|-----------------------------------|-----------------------------------|--|-----------------------|--------------|-----------------------------------|-------------------|
| BUDGET ACTIVITY PE NUMBER AND TITLE 01 Basic Research 0601102F Defense Rese Sciences Sciences | | | | | rch | PROJECT NUMBER AND TITLE 2301 Physics | | | | |
| (U) (U) CONGRESSIONAL ADD: Non- (U) In FY 2003: Not Applicable. (U) In FY 2004: Conduct fundamenta research. (U) In FY 2005: Not Applicable. (U) Total Cost | _ | _ | - | | weapons | | 0.000 23.487 | | 0.496 25.749 | 0.000 |
| (U) <u>C. Other Program Funding Sur</u> (U) Related Activities: PE 0602203F, Aerospace Propulsion. PE 0602204F, Aerospace Sensors. PE 0602500F, (U) Multi-Disciplinary Space Technology. (U) PE 0602601F, Space Technology. (U) PE 0602605F, Directed Energy Technology. (U) <u>D. Acquisition Strategy</u> Not Applicable. | <u>FY 2003</u> <u>Actual</u> | FY 2004 Estimate | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2</u> Esti | 2009 mate | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| Project 2301 | | | R-1 Shopping List | - Item No. 1-6 of 1 | -48 | | | E | Exhibit R-2a (| PE 0601102F) |

| | Ex | hibit R-2a, F | RDT&E Pro | oject Justifi | ication | | | DATE | February | 2004 |
|------------|--|---|---|--|---|--|---|---|---|------------------------------|
| | GET ACTIVITY Basic Research | | | 0 | PE NUMBER AND 1601102F Def 160iences | | ch | PROJECT NUME 2302 Solid M | | Structures |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 2302 | | 11.236 | 11.641 | 13.276 | 14.873 | 16.594 | 17.314 | 18.535 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) | A. Mission Description and Budget Ite Solid mechanics and structures basic rese phenomena ranging from micro-level del safe, reliable operation of superior Air Fo actuators, and control systems integrated modeling of non-linear static/dynamic be nano-materials; and composite materials | earch aims to important aims to important and fraction and fractories weapon and to accomplish dechavior of structures are structed at the structure of structures are structures and the structures are | acture of mater defensive syst amage control, | ials to the struc tems. Fundame , thermal manag | ctural dynamics ental knowledge gement, vibratie | of large platfo e of "multi-fund on reduction, an | rms. The goal ctional" structu nd reconfigura | s are cost-effect tres with smart t ble shapes. Res | tive development materials, senso search topics ind | nt and ors, clude: the |
| (U) | B. Accomplishments/Planned Program | (\$ in Millions) | | | | | FY | 2003 | FY 2004 | FY 2005 |
| | MAJOR THRUST: Explore advanced, na | | uls, mechanics, | and devices fo | or direct applica | tion in | | 2.540 | 2.478 | 6.357 |
| | advanced turbine engines, air vehicles, spa | | | | | | | | | |
| (U) (U) | In FY 2003: Conducted research in mech- composites, high-temperature alloys, and nonlinear behavior to begin designing mut- multi-scale modeling and information tech In FY 2004: Enhance research in the mec- composites, high-temperature alloys, and with nonlinear behavior to enhance design methods to combine multi-scale modeling Examine the foundations of nano-mechan- In FY 2005: Advance research in the mec- multi-functional design, diagnostics, prog- management, and energy harvest. Search in the design of new materials and structure continuum mechanics to atomistic modeling | ceramic matrix c lti-functional ma mology to design hanics of advance ceramic matrix c of multi-function and information ics in transitioning chanics of materia nostics, self-heal for methods to c res. Continue na | composites. Ap terials and strue n new materials and materials ar composites. Co- onal materials ar a technology to ng between cor als and devices ing, micro-/nar combine inform no-mechanics | pplied multi-fun actures. Develo s and structures nd devices to ac ontinue to apply and structures. o design new ma ntinuum mecha s, with continue no-mechanics, nation technolog research to pro | nctional mecha oped methods to s. ccelerate their u y multi-function Continue deve aterials and stru- nics and atomis ed focus in the autonomics, the gy and multi-sco- omote the transi | nics with o combine use as nal mechanics lopment of actures. stic modeling. areas of ermal cale modeling tion from | | | | |
| (U) | to this activity. | | | | | | | | | |
| · / | MAJOR THRUST: Analyze and model st Air Force weapon systems. | tructural fatigue | and loss of inte | egrity to mitiga | te their detrime | ental impact to | | 4.506 | 4.965 | 0.000 |
| Pro | ject 2302 | | R-1 S | hopping List - Ite | m No. 1-7 of 1-48 | 3 | | | Exhibit R-2a (F | PE 0601102F) |
| · | | | | 7 | | | | | | |

| BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUME 01 Basic Research 0601102F Defense Research 2302 Solid M (U) In FY 2003: Researched the structural and material aspects of high-cycle metal fatigue and other aging mechanisms of aircraft. Explored metal fatigue-generation caused by the vibration of compressor and turbine blades and blade motion/fluid flow coupling. Improved fundamental computer simulations to predict structural response to assorted stimuli. Investigated material science to identify and mitigate material degeneration and degradation. Advanced development of novel system techniques to analyze vehicle integrity. (U) In FY 2004: Continue to investigate the structural and material aspects of high-cycle metal fatigue and other aging mechanisms. Continue to explore metal fatigue-generation caused by the vibration of compressor and turbine blades. Expand and enhance fundamental computer simulations to predict structural response to assorted stimuli. Explore | February 2 BER AND TITLE lechanics and | |
|--|--|--------------|
| of aircraft. Explored metal fatigue-generation caused by the vibration of compressor and turbine blades and blade motion/fluid flow coupling. Improved fundamental computer simulations to predict structural response to assorted stimuli. Investigated material science to identify and mitigate material degeneration and degradation. Advanced development of novel system techniques to analyze vehicle integrity. (U) In FY 2004: Continue to investigate the structural and material aspects of high-cycle metal fatigue and other aging mechanisms. Continue to explore metal fatigue-generation caused by the vibration of compressor and turbine blades. | | |
| mechanisms. Continue to explore metal fatigue-generation caused by the vibration of compressor and turbine blades. | | |
| material science research to identify and mitigate material degeneration and degradation. Continue to develop novel system techniques to analyze vehicle integrity. | | |
| (U) In FY 2005: Not Applicable. Note: In FY 2005, these efforts will be moved to the "structural fatigue and mechanics" activity in this Project. | | |
| (U) (U) MAJOR THRUST: Conduct structural mechanics research to examine innovative adaptive structure concepts to improve the design and performance of air and space systems to include multi-mission unmanned aerial vehicles (UAVs). | 4.198 | 0.000 |
| (U) In FY 2003: Developed models to predict the interaction between structural motion and high-speed aerodynamics characteristic of UAVs. Further investigated the behavior of distributed sensor and actuator systems. Explored the mechanical and dynamic behavior of micro- and nano-scale structures to achieve exceptional capabilities in micro-electro-mechanical systems and nano-electro-mechanical systems. | | |
| (U) In FY 2004: Expand models to predict the interaction between structural motion and high-speed aerodynamics characteristic of UAVs. Further probe the behavior of distributed sensor and actuator systems of aircraft. Continue exploring the mechanical and dynamic behavior of micro- and nano-scale structures to achieve exceptional capabilities in micro-electro-mechanical systems and nano-electro-mechanical systems. | | |
| (U) In FY 2005: Not Applicable. Note: In FY 2005, these efforts will be moved to the "structural fatigue and mechanics" activity in this Project. | | |
| (U) (U) MAJOR THRUST: Analyze structural fatigue and mechanics, adaptive structures, and material properties to improve 0.000 the design, robustness, and performance of air and space systems to include multi-mission unmanned aerial vehicles (UAVs). | 0.000 | 6.919 |
| (U) In FY 2003: Not Applicable.(U) In FY 2004: Not Applicable. | | |
| (U) In FY 2005: Continue to examine and analyze structural mechanics to include fatigue, integrity, high cycle metal fatigue, and other material aging phenomena. Investigate metal fatigue-generation caused by the vibration of | | |
| Project 2302 R-1 Shopping List - Item No. 1-8 of 1-48 | Exhibit R-2a (P | PE 0601102F) |

| E> | chibit R- | 2a, RDT&E | Project Jus | stification | | | DA | February | |
|---|---|---|---|---|--|---------------------|--------------------|-----------------------------------|-------------------|
| BUDGET ACTIVITY 01 Basic Research | | | | PE NUMBER A 0601102F D Sciences | ND TITLE Defense Resea | rch | | JMBER AND TITLE I Mechanics an | |
| compressors and turbine blades. Continue degeneration and degradation. Continue models of interaction between UAV struct and actuator systems. Explore the mecha FY 2005, these efforts were covered under (U) Total Cost (U) <u>C. Other Program Funding Summary</u> | developing ctural motio inical and d er other acti | novel system te on and high-spee ynamic behavic vities in this Pro ons) | echniques to ana ed aerodynamics or of micro/nano oject. | lyze vehicle inte s. Characterize c -scale structures | egrity. Advance listributed senso . Note: Prior to | r) | 11.236 | 11.641 | 13.276 |
| E (U) Related Activities: (U) PE 0602102F, Materials. (U) PE 0602201F, Aerospace Flight Dynamics. (U) PE 0602202F, Human Effectiveness Applied Research. (U) PE 0602203F, Aerospace Propulsion. (U) PE 0603211F, Aerospace Structures. (U) D. Acquisition Strategy Not Applicable. | <u>Y 2003</u> <u>Actual</u> | <u>FY 2004</u> Estimate | FY 2005 Estimate | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> Estimate | FY 2008 Estimate | FY 2009 Estimat | | <u>Total Cost</u> |
| Project 2302 | | | R-1 Shopping List | - Item No. 1-9 of 1 | -48 | | | Exhibit R-2a | (PE 0601102F) |

| | Ex | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|------|----------------------------|-------------------|---------------------|---------------------|--|---------------------|---------------------|-----------------------------|---------------------|-------|
| | T ACTIVITY sic Research | | | 0 | PE NUMBER AND 0601102F Defe Sciences | | | PROJECT NUME 2303 Chemis | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| 2303 | Chemistry | 27.987 | 27.939 | 29.292 | 28.531 | 31.485 | 28.218 | 28.698 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

(U) A. Mission Description and Budget Item Justification

Chemistry basic research seeks bold innovations in understanding, modeling, and controlling chemical reactions for developing new materials, improving synthesis of existing materials, controlling energy flow and storage, and regulating interactions between materials and their environments. Studies expand fundamental understanding of properties regulating the chemical dynamics and energy transfer processes that foster advances in laser weaponry and allow predictions of the infrared, optical, and radar signatures of reaction products and intermediates that advance reliable target assessment and tracking. Critical research topics include: novel synthesis and characterization of lower cost, higher performance functional and structural materials, electronics, and photonic materials; nano-structures; electromagnetics; and conventional weaponry. Focused investigations include the effects of chemical and morphological structures on functional and mechanical properties of polymeric materials and the exploration of atomic and molecular surface interactions that limit performance of electronic devices, compact power sources, and lubricant materials. Primary areas of research include molecular reaction dynamics; theoretical chemistry; polymer chemistry; and surface and interfacial science.

| (U) | B. Accomplishments/Planned Program (\$ in Millions) | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
|-----|--|----------------|----------------|----------------|
| (U) | MAJOR THRUST: Research and characterize molecular dynamics, reaction mechanics/interactions, and theoretical | 10.776 | 11.654 | 13.523 |
| | chemistry to model, predict, control, and exploit atomic and molecular energetics and reactivities for advanced fuels, | | | |
| | munitions, and countermeasure techniques, as well as drag reduction. | | | |
| (U) | In FY 2003: Modeled interactions between aerospace systems and the space environment. Explored uses of ion and | | | |
| | plasma chemistry for flow control applications. Investigated concepts of reactive energetic nano-structures for | | | |
| | applications to propulsion and munitions. Developed and began to validate theoretical methods to predict and design | | | |
| | behavior and properties of nano-structures. Modeled chemically reacting flows associated with hypersonic vehicles. | | | |
| | Researched new chemical sources of electronic excited states needed to fuel chemical laser systems. | | | |
| (U) | In FY 2004: Complete modeling efforts of the chemical interactions between air and space systems and the space | | | |
| | environment. Explore uses of ion and plasma chemistry for combustion control applications. Investigate concepts of | | | |
| | reactive energetic nano-structures for safer penetrating munitions and enhanced spacecraft payload fractions. Develop | | | |
| | and validate theoretical methods to predict and design the behavior and properties of nano-structures. Probe novel | | | |
| | chemical theories, syntheses, detection techniques, and modeling and simulation focused on fuels and rocket | | | |
| | propellants that are more energetic, environmentally benign, and emit reduced signatures and are less sensitive to | | | |
| | accidental detonations. Study the fundamental behavior of new fuels in hydrocarbon-fueled scramjets and | | | |
| | combined-cycle engines. Enhance models of chemically reacting flows associated with hypersonic vehicles. | | | |
| | Research new chemical sources of electronic excited states needed to fuel chemical laser systems. Optimize | | | |
| | properties of potential fuels to increase the mass of space payloads and satellite lifetimes. | | | |
| Pro | ject 2303 R-1 Shopping List - Item No. 1-10 of 1-48 | | Exhibit R-2a | (PE 0601102F) |

| Exhibit R-2a, RDT&E | Project Justification | DA | February | 2004 |
|---|--|-------------------------|-----------------|--------------|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | PROJECT NL 2303 Chen | JMBER AND TITLE | |
| (U) In FY 2005: Explore ion and plasma chemistry for combustion cont concepts and models for propulsion and munition reactive energetics associated with hypersonic vehicles, hydrocarbon-fueled scramjets, a optimize chemical properties enriching high-energy lasers, advancin enhancing space lift, and extending time-on-orbit/station. (U) | s. Continue modeling chemically reacting flows and combined-cycle engines. Continue to | | | |
| (U) MAJOR THRUST: Research super energetic propellants through ch techniques, as well as modeling and simulation focused on fuels and (U) In FY 2003: Studied the application of potential fuels for hydrocarb Identified and investigated potential fuels increasing the mass of pay satellites on orbit. | rocket propellants. on-fueled scramjets and combined-cycle engines. | 2.036 | 0.000 | 0.000 |
| (U) In FY 2004: Not Applicable. Note: In FY 2004, these efforts were a mechanics/interactions, and theoretical chemistry" activity in this Pr (U) In FY 2005: Not Applicable. (U) | · · · · · · · · · · · · · · · · · · · | | | |
| (U) MAJOR THRUST: Enhance fundamental understanding of polymerengineering, processing controls, and materials technologies to deveraimed at improving Air Force systems performance and life-spans to (U) In FY 2003: Explored magnetic, conductive, and optical properties | lop advanced organic and matrix composites a allow effective air and space persistence. | 9.273 | 9.286 | 8.737 |
| concepts with on-demand tunable properties. Investigated bio-inspin photonic properties and photonic bandgap structures. Explored mole controllable mechanical actuation in polymeric materials. Exploited | red polymer concepts to achieve enhanced ecular conformational changes to achieve | | | |
| (U) In FY 2004: Develop organic molecules with high optical nonlinear flexible structures that can provide functions such as sensing, power electronic memory for integration into multi-functional structures. If performance for photonic radar development. Research organic-bas | ities for protection against laser threats. Explore generation and storage, electronics, and Enhance electro-optic polymers for improved | | | |
| (U) In FY 2005: Design and characterize conductive polymers, photonic polymers. Evaluate nano-composite structures and mechanical prop environments. | c polymers, nano-structures, and bio-inspired | | | |
| (U) (U) MAJOR THRUST: Expand the fundamental chemistry and physics corrosion protection, wear reduction, micro- and nano-assemblies, at (U) In FY 2003: Developed theoretical and predictive methods for surface physical properties of novel lubricants to create new low-friction, low | nd power storage for air and space systems. ace and interfacial chemical processes. Explored | 5.902 | 6.007 | 7.032 |
| | R-1 Shopping List - Item No. 1-11 of 1-48 | | Exhibit R-2a (F | PE 0601102F) |

| | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | DATE | February | 2004 |
|---|--|--|--|---|--|-----------------------------------|-----------------------------------|-----------------------------------|-------------------|
| BUDGET ACTIVITY 01 Basic Research | | | | PE NUMBER A 0601102F D Sciences | ND TITLE efense Resea | rch | PROJECT NUM 2303 Chemis | BER AND TITLE | 2004 |
| terrestrial and space environments. I weapon system energy storage and d optical, and power applications. (U) In FY 2004: Improve theoretical and chemical and physical properties of fu- protection of aging aircraft. Develop Continue probing nano-scale surface storage and delivery. Study chemica nano-structures for sensor, optical, a (U) In FY 2005: Enhance theoretical and characterize novel multi-functional s nano-scale surface structures for enh surfaces for sensor, optical, and pow racions. | d predictive met novel lubricants p low-friction, lo e structures with ally directed self nd power applic d predictive met surface structure anced energy-do | ched novel three hods for surface . Assemble nov ong-life multi-fu enhanced energ f-assembly to pr ations. hods for surface s, coatings, cove ensity storage/de | e-dimensional su e and interfacial of rel multi-function unctional surface gy densities for b oduce novel thre e and interfacial of ers, and lubrican elivery and chem | chemical process nal coatings for structures and c etter weapon sy e-dimensional s chemical process ts. Continue inv ically-directed | ctures for sensor ses. Explore the the corrosion coatings. stem energy urface ses. Create and vestigating self-assembled | | | | |
| regions. (U) (U) CONGRESSIONAL ADD: Corrosid (U) In FY 2003: Not Applicable. (U) In FY 2004: Advance fundamental se aluminum alloys used in air and space (U) In FY 2005: Not Applicable. (U) Total Cost | scientific researc | | - | | tection of | | 0.000 27.987 | 0.992 27.939 | 0.000 29.292 |
| (U) <u>C. Other Program Funding Summ</u> | narv (\$ in Milli | o ns) | | | | | | | |
| (U) Related Activities: (U) PE 0602102F, Materials. (U) PE 0602203F, Aerospace Propulsion. PE 0602500F, (U) Multi-Disciplinary Space Technology. (U) PE 0602601F, Space Technology. | FY 2003 Actual | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| Project 2303 | | F | R-1 Shopping List - | Item No. 1-12 of | 1-48 | | | Exhibit R-2a | (PE 0601102F) |

| EXhibit R-2a, RDT&E Project Justification February 2004 BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND TITLE PROJECT NUMBER AND TITLE 2303 Chemistry D1 Basic Research Sciences Sciences 2303 Chemistry U) C. Other Program Funding Summary (\$ in Millions) PE 0602602E Conventioned PE 0602602E Conventioned | | UNCLASSIFIED | DATE |
|--|--------------------------------------|---|--------------------------|
| BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND TITLE 01 Basic Research 0601102F Defense Research 2303 Chemistry U) C. Other Program Funding Summary (\$ in Millions) PE 0602602F, Conventional U) PE 0602602F, Conventional Yes 0602602F, Conventional Munitions. U) D. Acquisition Strategy | Exhibit R-2a, RD | F&E Project Justification | February 2004 |
| PE 0602602F, Conventional Munitions. D. Acquisition Strategy | BUDGET ACTIVITY D1 Basic Research | 0601102F Defense Research | |
| | | | |
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| | | | |
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| | | | |
| | | | |
| | | | |
| Project 2303 R-1 Shopping List - Item No. 1-13 of 1-48 Exhibit R-2a (PE 060) | Preiest 2202 | D 4 Shapping Lint Jtem No. 4 40 cf 4 40 | Exhibit R-2a (PE 0601102 |

| | Ext | nibit R-2a, I | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|------------|--|---|---|---|--|--|-------------------------------|---|-----------------------------------|---------------------|
| | GET ACTIVITY asic Research | | | 0 | PE NUMBER AND 1601102F Defe Sciences | | :h | PROJECT NUMBER AND TITLE 2304 Mathematical and Compute Sciences | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ III MIIIIOIIS) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 2304 | Mathematical and Computer Sciences | 31.286 | 29.293 | 25.663 | 34.397 | 39.314 | 35.952 | 32.022 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles In FY 2005, some activities in this projec | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) | A. Mission Description and Budget Item Mathematics and computing sciences basic control, and innovative analytical and high performance and control of systems and so theories. The primary areas of research in mathematics; computational mathematics | ic research deve h performance ubsystems thro westigated by t | computing met ugh accurate m his project are | hods for air and odels and com | d space systems putational tools | Basic researce , artificial intell | h provides fur igence, and in | ndamental know | vledge enabling mming techniqu | improved ues and |
| (U) | B. Accomplishments/Planned Program (| \$ in Millions) | | | | | FY | <u>7 2003</u> | FY 2004 | FY 2005 |
| (U) (U) | MAJOR THRUST: Perform dynamics and control systems in order to enhance capabil In FY 2003: Performed research on cooper applications to swarms of smart munitions, Explored means to improve control of non- reacting flows) with applications to combu- and sensor technology that can be utilized in Commenced designing computational mod In FY 2004: Continue research on coopera applications to swarms of smart munitions, methodology to improve non-equilibrium the with applications to combustion, materials processing and sensors applicable to advan Enhance designs of computational models explorations in bio-inspired sensing system autonomous systems. In FY 2005: Advance research on coopera applications to swarms of smart munitions, methodologies to improve non-equilibrium combustion, materials processing, and agile | lities and performative control in unmanned aer equilibrium beh stion, and mate in UAV control els to analyze r ative control in UAVs, and co behavior of com processing, and ced UAV contri to analyze natu as to assess feas tive control in a UAVs, and co | mance of air a dynamic, unc al vehicles (U avior of comp rials processin lers, smart mu atural processes dynamic, unce nstellations of oplex, unsteady l agile autonom ollers, smart m ral processes fe ibility for and dynamic, uncer nstellations of mplex, unstead | nd space vehicle ertain, adversar AVs), and cons lex, unsteady fl g. Fostered advector nitions, and not es for adaptatio rtain, adversaria small satellites. of fluid systems nous flight. Ex- nous flight. Ex- non adaptation to applicability in rtain, adversaria small satellites. dy fluid systems | les. rial environmen itellations of sm uid systems (ch vances in image ndestructive vel n to air and spa al environments . Develop contr (chemically rea plore advances on-destructive air and space s use in controlli- al environments . Further develops with application | tts with aall satellites. emically processing nicle testing. ce systems. s with rol cting flows) in image vehicle testing. systems. Adapt ing s with op control ons for | | 6.172 | 6.488 | 7.735 |
| | ect 2304 | | • | - | m No. 1-14 of 1-4 | • | | | Exhibit R-2a (F | PE 0601102F) |
| | | | 1.10 | | | ~ | | | | = 00011021 / |

| Exhibit R-2a, RDT&E | Exhibit R-2a, RDT&E Project Justification | | | | | |
|--|--|-------|-----------------|--------------|--|--|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | | February 2004 | | | |
| sensor technologies for use in UAV controllers, smart munitions, and | • • | | | | | |
| adaptation of bio-inspired sensing systems, controls, and computation | nal methods. | | | | | |
| (U) | and the section for the second second second | 2.972 | 2.504 | 0.000 | | |
| (U) MAJOR THRUST: Investigate signal communications, surveillance | | 2.872 | 2.504 | 0.000 | | |
| improved command and control for the battlefield commander. Effo | · · | | | | | |
| generalized functions and probability, harmonic methods, and asymp | - | | | | | |
| (U) In FY 2003: Conducted investigations to expand the capability of cr surveillance/reconnaissance and targeting systems through examination | | | | | | |
| analysis. Explored source-channel encoding methods for robust wire | | | | | | |
| phenomenology. Developed a rigorous basis for and commenced de | | | | | | |
| self-learning, trial and error (heuristic) methods such as super-resolution | | | | | | |
| higher information rates and higher reliability of communications. | tion mugnig. Resourced technologies with | | | | | |
| (U) In FY 2004: Continue investigations to expand the capability of critic | ical mobile, networked communications through | | | | | |
| mathematical innovations in signal processing. Explore hybrid radio | - | | | | | |
| achieve robust wireless communication. Further delineate the domai | | | | | | |
| methods such as super-resolution imaging. Examine the fundamenta | | | | | | |
| analysis to actuate proof-of-concept surveillance/reconnaissance and | | | | | | |
| technologies that attain ultra-fast, reliable information exchange. En | | | | | | |
| functions, differential equations, and quantum theory to facilitate flex | | | | | | |
| multi-source data. | | | | | | |
| (U) In FY 2005: Not Applicable. Note: In FY 2005, these activities will | be moved to Project 2311 in this Program | | | | | |
| Element. | | | | | | |
| (U) | | | | | | |
| (U) MAJOR THRUST: Conduct research in complex systems and algor | | 6.172 | 6.261 | 0.000 | | |
| information systems supporting battlefield commanders; using artific | | | | | | |
| agents, knowledge bases, distributed systems, machine learning, unc | ertainty reasoning, and intelligence/ information | | | | | |
| assurance, and information fusion. | | | | | | |
| (U) In FY 2003: Explored methods to enhance research in information of | | | | | | |
| security, mobile code security, protected execution, and dynamic, ad | | | | | | |
| battlespace/infosphere systems and networks. Developed new comp | utational techniques/software in extremely large | | | | | |
| (10,000,000+ axioms) knowledge bases to provide decision support. | | | | | | |
| (U) In FY 2004: Continue research in information assurance, including s | | | | | | |
| security, protected execution, steganography/steganalysis, dynamic, | | | | | | |
| future battlespace/infosphere systems and networks. Further develop | | | | | | |
| Project 2304 R | -1 Shopping List - Item No. 1-15 of 1-48 15 | | Exhibit R-2a (I | PE 0601102F) | | |

| Exhibit R-2a, RDT&E | DA | February 2004 | | | |
|---|--|---------------|--|-----------------------|--|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | | JMBER AND TITLE ematical and Computer | | |
| information fusion at the situation refinement and impact assessme quantum computer devices that enable atomic level computing a m chip to allow enhanced target tracking, command and control, and quantum computing algorithms and architectures enabling fast, acc problems eliminating the need for multiple design iterations and pr computers for automatic target recognition and target characterizat (U) In FY 2005: Not Applicable. Note: In FY 2005, these activities w Element. (U) | illion times faster than a state-of-the-art silicon decisive awareness. Design, implement, and test urate solutions of complex fluid dynamics ototype testing. Develop scalable quantum ion. | | | | |
| (U) MAJOR THRUST: Research physical mathematics, applied analy (U) In FY 2003: Researched developing accurate models of physical p and predictability of devices. Investigated the properties of cohere air and their exploitation in areas such as electronic warfare and las simulate nonlinear optical effects within semiconductor lasers and of optimal electromagnetic wave propagation/scattering codes to pr Evaluated methods to penetrate tree cover with wide band radar to of designing reconfigurable warheads by suitable placement/timing internal stores released from transonic/supersonic platforms. | henomena to enhance the fidelity of simulations ntly propagating ultrashort laser pulses through the ser-guided munitions. Developed algorithms to nonlinear optical media. Improved the formulation rovide accurate and timely target recognition. recognize and track targets. Studied the feasibility | 6.613 | 6.216 | 8.257 | |
| (U) In FY 2004: Continue research to develop accurate models of physisimulations and predictability of devices. Further investigate the p pulses through the air and their exploitation in areas such as electror irradiation of chemical/biological clouds. Develop algorithms to si and nonlinear optical media. Complete formulating optimal electror provide accurate and timely target recognition. Continue evaluatin band radar to recognize and track targets. Continue studying the fe suitable placement/timing of microdetonators. Enhance description transonic/supersonic platforms. | roperties of coherently propagating ultrashort laser onic warfare, laser-guided munitions, and mulate nonlinear optical effects within fiber lasers omagnetic wave propagation/scattering codes to g novel methods to penetrate tree cover with wide easibility of designing reconfigurable warheads by n of the dynamics of internal stores released from | | | | |
| (U) In FY 2005: Continue research to develop models of physical phen predictability. Investigate methods to advance target location, reco properties of coherently propagating ultra-short laser pulses throug nonlinear optical effects within fiber lasers and nonlinear optical m transonic/supersonic/hypersonic platforms and warhead reconfigur | gnition and identification, and tracking. Probe the h the atmosphere. Evaluate algorithms of edia. Study the dynamics of | | | | |
| (U)(U) MAJOR THRUST: Investigate optimization and discrete mathema Project 2304 | ntics to validate and further advance mathematical R-1 Shopping List - Item No. 1-16 of 1-48 16 | 4.897 | 4.382 Exhibit R-2a (F | 0.000 PE 0601102F) | |

| Exhibit R-2a, RD | DA | February | 2004 | | |
|--|--|----------|------------------|-------|--|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | | NUMBER AND TITLE | | |
| methods, algorithms, and models. (U) In FY 2003: Conducted research for solving complex problem planning for battlespace information management. Evaluated not necessarily optimal, solution. Examined new modeling tersuch as target tracking, mobilization planning, and manufacture (U) In FY 2004: Enhance research for solving complex problems contingencies, and strategic/tactical planning for battlespace in algorithms those that produce a feasible, but not necessarily techniques and algorithms for various Air Force current and lo unmanned air vehicles, special operations planning, and system (U) In FY 2005: Not Applicable. Note: In FY 2005, these activity mathematics research " efforts in this Project. | ms in logistics, engineering design, and strategic/tactical anytime algorithms those that produce a feasible, but echniques and algorithms for various Air Force problems uring. 5 in system diagnostics/prognostics, air mobility nformation management. Further evaluate anytime y optimal, solution. Continue examining new modeling ong-term challenges, such as target allocation for m health and maintenance. | | | | |
| (U) (U) MAJOR THRUST: Perform computational mathematics reserve capabilities to improve designs of advanced Air Force systems (U) In FY 2003: Devised means to integrate new multi-disciplinar time-accurate solvers in order to design superior jet engines, a components. Developed new algorithms for unsteady reactive plasma dynamics for directed energy weapons. Developed qu implementations to enable exponential improvements in speed signal processing, and data mining. | is. ry design optimization strategies with high-order, aircraft wings, munitions, and other aerospace e flow, munitions penetration and fragmentation, and uantum computing algorithms, architectures, and | 4.560 | 3.442 | 0.000 | |
| (U) In FY 2004: Initiate the integration of new multi-disciplinary of time-accurate solvers for superior design of jet engines, aircra components. Continue developing algorithms for unsteady rea and plasma dynamics for directed energy weapons. Compute aerodynamic flows and structural failure predictions. (U) In FY 2005: Not Applicable. Note: In FY 2005, these activities mathematics research" efforts in this Project. | aft wings, munitions, as well as other air and space eactive flow, munitions penetration and fragmentation, the simulation uncertainty in nonlinear models of | | | | |
| (U) (U) MAJOR THRUST: Conduct research in optimization, as well and further advance mathematical methods, algorithms, and m designs of advanced Air Force systems. (U) In FY 2003: Not Applicable. (L) In FX 2004: Not Applicable. | | 0.000 | 0.000 | 9.671 | |
| (U) In FY 2004: Not Applicable. Project 2304 | R-1 Shopping List - Item No. 1-17 of 1-48 | | Exhibit R-2a (F | | |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|-------------------|--|--|--|---|--|--|-----------------------------------|-----------------------------------|-----------------------------------|-------------------|
| | Sciences Science | | | | | | | | | |
| | In FY 2005: Solve complex proble strategic/tactical planning for battle various present day and longer term high-order, time-accurate solutions penetrators, air and space component simulation uncertainty in non-linear FY 2005, these activities were cover Total Cost | space information in challenges. Inter- for superior designts, and system h r models of aerod | n management. ggrate new multi gn of jet engines ealth and mainte ynamic flows a | Design modelir i-disciplinary de s, directed energ enance systems. nd structural fail | ng techniques and sign optimizatio y devices, munit Continue comp | d algorithms for n strategies with ions and uting the | | 31.286 | 29.293 | 25.663 |
| (U) | C. Other Program Funding Sum | mary (\$ in Milli | ons) | | | | | | | |
| (U) (U) (U) | | <u>FY 2003</u> <u>Actual</u> | FY 2004 Estimate | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| (U) Pro | D. Acquisition Strategy Not Applicable. | | F | R-1 Shopping List - | - Item No. 1-18 of ² | 1-48 | | | Exhibit R-2a | (PE 0601102F) |

| | Ext | nibit R-2a, F | RDT&E Pro | oject Justif | ication | | | I | DATE February | / 2004 |
|-----|---|---|---|---|---|--|--|--|---|---------------------------|
| | GET ACTIVITY Basic Research | | | C | PE NUMBER AND 0601102F Defe Sciences | | :h | | NUMBER AND TITLE Ectronics | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 20 | | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estima | | |
| 230 | | 23.234 | 25.041 | 25.174 | | 29.722 | 29.674 | | 0.117 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | |
| (U) | A. Mission Description and Budget Item Electronics basic research enhances the fu energy weapons, stealth technologies, elec electronic processes to model and predict and high-speed signal processing. The go processing speeds, and to improve the sec semiconductor materials; optoelectronic in | indamental und ctronic counterr the performanc pals are to firmly urity and reliab | neasures, infor e of electronic y control the co ility of electron | mation and sig materials, devi omplexity and n nic information | nal processing, ices, and system reliability of ele n. The primary | and communic ns for power get ectronic systems areas of researc | ations. This r neration, optic s, increase dat | esearch en cal signal p a transmis | ables the developm processing, radiation sion and information | ent of n effects, n |
| (U) | B. Accomplishments/Planned Program (| <u>\$ in Millions)</u> | | | | | FY | <u> 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| (U) | MAJOR THRUST: Assess military space survivability, and functionality while simul spacelift, battlefield awareness and control. In FY 2003: Expanded studies of intense r Commenced designing, fabricating, and ev combination of high RF power output, high reconfigurable electronics. Conducted rese Developed models to predict the effect of to order to promote secure, wide-bandwidth c satellites. Initiated joint Air Force-NASA their demonstrations. In FY 2004: Probe intense RF pulse effect | Itaneously reduce, mission flexib adio frequency aluating wide b n efficiency, low earch on the inter- errestrial and sp communication program in unit s on electronic | cing component ility, and ease (RF) pulse effort andgap semicory v noise, robusts eraction of syster bace background through the attri- versity nano-sater circuits and system | at cost, size, and of augmentatio ects on electror onductor materi- ness, and radiation ress, and senso ads and radiation nosphere and in atellites, seekin stems. Design, | d weight in orde on and upgrade. nic circuits and ials to achieve a tion hardness. I rs with the spac on on sensor per onosphere as we g novel space in , fabricate, and o | er to improve systems. a unique Examined ee environment. formance in ell as between nnovations and evaluate wide | | 8.143 | 8.428 | 6.573 |
| Pro | bandgap semiconductor materials to achiev noise, robustness, and radiation hardness. I survivability. Enhance research on the inter development of models to predict the effec in order to promote secure, wide-bandwidth between satellites. Explore design and po space and flexible mission capabilities. Re and power, smart skins, radiation hardening ject 2305 | Evaluate efforts eraction of syste t of terrestrial a h communication otential applicat esearch scientifi | to identify ele ems and sensor nd space backg on through the ions of small sa c barriers to co effect electron | ectronic approa s with the spac grounds and rac atmosphere and atellites (1kg to omponent minia ics. Continue | ches to increasi e environment. diation on senso d ionosphere as o 100 kg) for raj aturization, nano | ng spacecraft Continue or performance well as pid access to o-propulsion NASA | | | Exhibit R-2a | (PE 0601102F) |

| Exhibit R-2a, RDT&E Proj | February 2 | 2004 | | |
|---|--|--------------------------|---------------------------|--------------|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | PROJECT NU 2305 Elect | IMBER AND TITLE ronics | |
| university nano-satellite projects with emphasis on space industry partners (U) In FY 2005: Further investigate effects of intense RF pulses on electronic fabricating, and evaluating wide bandgap semiconductor materials toward power output, high efficiency, low noise, robustness, and radiation hardne component miniaturization, nano-propulsion and power, smart skins, radia electronics. Complete specific Air Force-NASA nano-satellite projects. (U) | c circuits and systems. Continue designing, ls achieve an unique combination of high RF ess. Research scientific barriers to electronic | | | |
| MAJOR THRUST: Conduct semiconductor materials research for detective the far infrared to ultraviolet range to achieve spectral dominance of the butracking, and target signature identification. | - | 7.127 | 7.580 | 0.000 |
| (U) In FY 2003: Investigated unique nonlinear optical materials to protect cri Synthesized laser materials to degrade or disable an adversary's detection development of nano-fabrication technology for unique optoelectronic ma mechanisms to improve the efficiency and reduce the cooling requirement multi-band detectors for battlespace characterization. | and tracking capabilities. Initiated aterial properties. Assessed basic electronic | | | |
| (U) In FY 2004: Continue pursuit of nonlinear optical materials to protect crit Synthesize laser materials to degrade or disable an adversary's detection a nano-fabrication technology for unique optoelectronic materials. Continu improve the efficiency and reduce the cooling requirements of lasers and detectors for battlespace characterization. Identify new materials for high temperature ferromagnets, and compact, high-power semiconductor lasers | nd tracking capabilities. Enhance e assessing basic electronic mechanisms to detectors. Evaluate fast multi-band efficiency photovoltaic devices room | | | |
| (U) In FY 2005: Not Applicable. Note: In FY 2005, these activities will be r materials" efforts in this Project. | noved to the "quantum and optoelectronic | | | |
| (U) (U) MAJOR THRUST: Conduct research in optoelectronic information procedesign, development, and application of novel optoelectronic materials and communication system accuracy and speed. (U) In FY 2003: Examined complex semiconductor structures and developed | d devices to enhance critical | 2.376 | 2.281 | 0.000 |
| (b) In FF 2005: Examined complex semiconductor structures and developed multi-wavelength modulators and detectors for satellite imaging and data nanotechnologies including nano-photonics, nano-electronics, and nano-se technologies. | transfer. Explored optoelectronic | | | |
| (U) In FY 2004: Continue exploration of ultracompact, micro-photonic, and r optical networks. Expand investigation of robust monolithic and miniatur remote sensing, optical communications, and optical signal processing. Ir | re tetrahertz frequency devices for security, | | | |
| Project 2305 R-1 Sho | opping List - Item No. 1-20 of 1-48 | | Exhibit R-2a (F | PE 0601102F) |

| Exhibit R-2a, RDT&E Project Justification | DA | TE | 2004 | |
|---|--|-------|--------|--|
| BUDGET ACTIVITY PE NUMBER AND TITLE 01 Basic Research 0601102F Defense Research Sciences Sciences | PROJECT NUMBER AND TITLE 2305 Electronics | | | |
| research.(U) In FY 2005: Not Applicable. Note: In FY 2005, these activities will be moved to the "quantum and optoelectronic materials" efforts in this Project. | | | | |
| (U)(U) MAJOR THRUST: Examine optoelectronic memory and persistent spectral hole-burning approaches for enhanced | 1.587 | 1.522 | 0.000 | |
| data storage and processing to enable superior strategic awareness. (U) In FY 2003: Investigated page-oriented or holographic memory configurations in two- or three-dimensions. Explored capabilities to buffer, store, and retrieve data at rates and quantities anticipated for multi-spectral devices. Developed new technologies to increase capabilities in high-speed image capture, data storage, and information processing for surveillance, target discrimination, and autonomous navigation. Advanced research on the interaction of systems and sensors with the space environment. | | | | |
| (U) In FY 2004: Continue investigating methods for constructing page-oriented or holographic memory configurations in two- or three-dimensions. Explore methods of buffering, storing, and retrieving data at rates and quantities anticipated for multi-spectral devices. Investigate techniques for enhancing capabilities in high-speed image capture, data storage, and information processing for surveillance, target discrimination, and autonomous navigation. | | | | |
| (U) In FY 2005: Not Applicable. Note: In FY 2005, these activities will be moved to the "quantum and optoelectronic materials" efforts in this Project. | | | | |
| (U) (U) MAJOR THRUST: Investigate quantum and optoelectronic materials, memory, and information processing, as well as nano-science for wide-field spectral sensors and critical, high-speed communication systems in order to achieve spectral dominance of the battlespace to include surveillance, target tracking, and target signature identification. | 0.000 | 0.000 | 13.545 | |
| (U) In FY 2003: Not Applicable.(U) In FY 2004: Not Applicable. | | | | |
| (U) In FY 2005: Continue exploring unique nonlinear optical and laser materials and fabrication processes for radiation protection, cloaking and tracking, and target signature identification. Improve efficiency and reduce cooling requirements of lasers and detector electronics. Explore ultracompact micro- and nano-photonic structures, chip-scale optical networks, and enhanced data storage (e.g., optoelectronic memory). Probe robust monolithic and miniature terahertz frequency spectrum devices and quantum cascade lasers. Investigate communication network technologies, room temperature ferromagnetic materials, and the interaction of system electronics and sensors with atmospheric and space environments. Note: Prior to FY 2005, these activities were covered under other efforts prior in this Project. | | | | |
| (U)(U) MAJOR THRUST: Investigate quantum electronic solids phenomena to explore superconducting, magnetic, and | 4.001 | 3.842 | 5.056 | |
| (U) MAJOK THRUST: Investigate quantum electronic solus plenomena to explore superconducting, magnetic, and nanoscopic materials for advanced sensing, communications, and signal processing. (U) In FY 2003: Examined superconducting quantum systems for adaptation to quantum computing and encryption. | 4.001 | 5.042 | 5.050 | |
| (0) In F 1 2005: Examined superconducting quantum systems for adaptation to quantum computing and encryption. | | | | |

| | Exhibit R- | 2a, RDT&F | Project Jus | tification | | | DA | ATE | |
|--|--|--|--|---|--|-----------------------------------|--------------------------------|--------------|-------------------|
| BUDGET ACTIVITY | | | | PE NUMBER A | | | | February | |
| 01 Basic Research | | | | | efense Resea | rch | 2305 Elec | | |
| Further investigated high-current, high and storage on Air Force directed ener materials with sufficient mechanical s (U) In FY 2004: Examine superconductinn Conduct research on improving high-orgeneration and storage on directed ener high-temperature magnetic materials workloads. | rgy weapons at trength for use g quantum sys current, high-te ergy weapons a | nd space platfor in aircraft with tems for adapta emperature supe and space platfo | ms. Developed higher electric v tion to quantum rconducting cab rms. Further the | new high-tempe vorkloads. computing and les and tapes for e development o | rature magnetic encryption. enhanced powe f new | | | | |
| (U) In FY 2005: Continue examining sup methodologies to fabricate high curren storage devices. Continue the develop strength for use in aircraft electrical sy | nt, high-temper oment of high- | ature supercond | lucting cables for | r enhanced pow | er generation an | | | | |
| (U) (U) CONGRESSIONAL ADD: Thin Film (U) In FY 2003: Not Applicable. (U) In FY 2004: Study the fundamental sc (U) In FY 2005: Not Applicable. | n Magnetic Ma | | with thin film n | nagnetic materia | ıls. | | 0.000 | 1.388 | 0.000 |
| (U) Total Cost | | | | | | | 23.234 | 25.041 | 25.174 |
| (U) <u>C. Other Program Funding Summa</u> | nry (\$ in Millio | ons) | | | | | | | |
| (U) Related Activities: PE 0602204F, Aerospace Sensors. (U) PE 0602702F, Command, Control, and Communications. (U) PE 0603203F, Advanced | FY 2003 Actual | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 200</u> <u>Estima</u> | | <u>Total Cost</u> |
| (U) Aerospace Sensors. (U) PE 0603789F, C3I Advanced Development. | | | | | | | | | |
| (U) D. Acquisition Strategy Not Applicable. | | | | | | | | | |
| Project 2305 | | F | R-1 Shopping List - | Item No. 1-22 of 22 | 1-48 | | | Exhibit R-2a | (PE 0601102F) |

| | ExI | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DAT | February | 2004 |
|--------------------------|--|---|---|---|--|---|---|--|--|------------------------|
| | GET ACTIVITY Basic Research | | | C | PE NUMBER AND 0601102F Defe Sciences | | :h | PROJECT NU 2306 Mater | MBER AND TITLE ials | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ III Millions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 230 | | 14.170 | 15.035 | 15.917 | 15.971 | 17.704 | 17.538 | | | 0.000 |
| <u> </u> | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | |
| (U) | A. Mission Description and Budget Iter Materials basic research enhances the per fatigue, and environmental conditions. The turbine engine, and spacecraft structures. and reliability, increase the operating term alloys, intermetallics, polymer compositer investigated by this project are ceramics, | formance, cost, his research exp The goals of th perature of engi s, metal and cera | ands fundament is project are to ne materials, a amic matrix co | ntal knowledge o develop impr nd further incro omposites, adva | e of material pro roved materials ease thrust-to-w anced ceramics, | perties that lead for air and space reight ratio of e | ds to the devel e vehicles than ngines. Basic | lopment of no at provide incr research emp | ovel materials for reased structural e bhasis is on refrac | airframe, fficiency |
| aD | B. Accomplishments/Planned Program (| (\$ in Millions) | | | | | F١ | <u>Y 2003</u> | FY 2004 | FY 2005 |
| (U) (U) (U) (U) | MAJOR THRUST: Identify ceramic and r for very-high (>1400F) and ultra-high (>25 In FY 2003: Investigated the optimization engine blade applications. Created ultra-hi applications. Worked toward designing an structural and functional ceramics to enable In FY 2004: Optimize the thermal and me applications. Extend research on ultra-high systems. Maintain research focus on the de structurally enhanced smart systems. In FY 2005: Not Applicable. Note: In FY this Project. MAJOR THRUST: Investigate organic ma can be used to increase the strength and life In FY 2003: Analyzed the effects of cyclic temperatures to increase durability in liquid | 500F) temperature of thermal and igh temperature ad optimizing mu e enhanced fuel chanical stabilit h temperature co esign and optim & 2005, all non-to atrix composites e span of air and c thermal loads | re applications mechanical sta materials syste ulti-functional cells, sensors, y of oxide com- eramic materia ization of multi- metallic efforts and hybrid m l space structur on polymer ma | s. ability of oxide ems based on n materials to en and actuators. aposites for airc ls for space pro- ti-functional ce s will be combi- aterials (includ ral materials. attrix composite | composites for non-oxide mater nable the combin craft and jet eng opulsion and str eramic materials aned into a single ling adhesives/e | aircraft and jet ials for space nation of tine blade uctural to enable e effort later in poxies) that genic | | 4.823 2.291 | 4.992 2.270 | 0.000 |
| (U) | reinforced structures to minimize degradat In FY 2004: Further probe the effects of c composites in order to increase durability i | ion of mechanic yclic thermal lo | al and electror ads down to cr | nagnetic prope yogenic tempe | erties due to moi eratures on poly | sture. ner matrix | | | | |
| Pro | ject 2306 | | R-1 SI | hopping List - Iter | m No. 1-23 of 1-4 | 8 | | | Exhibit R-2a (I | PE 0601102F) |

| Exhibit R-2a, RDT | DAT | DATE February 2004 | | |
|--|---|-----------------------|-----------------|--------------|
| BUDGET ACTIVITY 01 Basic Research | PROJECT NU 2306 Mater | MBER AND TITLE | | |
| in glass fiber reinforced structures to minimize the degradation moisture. | of mechanical and electromagnetic properties due to | | | |
| (U) In FY 2005: Not Applicable. Note: In FY 2005, all non-metal this Project. | ic efforts will be combined into a single effort later in | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Perform non-metallic, ceramic, and hybrid materials and composites with s very-high (>1400F) and ultra-h organic matrix composites and hybrid materials (including adhe application, and life span of air and space structural materials. | igh (>2500F) temperature applications. Create | 0.000 | 0.000 | 6.439 |
| (U) In FY 2003: Not Applicable. | | | | |
| (U) In FY 2004: Not Applicable. | | | | |
| (U) In FY 2005: Optimize the thermal and mechanical stability of c | | | | |
| Identify and design multi-functional ceramic materials to enable | | | | |
| research on very-high and ultra-high temperature ceramic mater | | | | |
| temperature) effects on organic and polymer matrix composites. | | | | |
| glass/carbon fiber reinforced structures. Note: Prior to FY 2005 | , these activities were covered under other efforts | | | |
| earlier in this Project. | | | | |
| (U)(U) MAJOR THRUST: Research metallic materials and identify re | ationships between structure (including | 7.056 | 7.773 | 9.478 |
| microstructure), processing, properties and performance so as to | | 7.050 | 1.115 | 2.176 |
| advanced engines and aerospace structural applications. | develop anoradore and darable meanine systems for | | | |
| (U) In FY 2003: Integrated computational modeling into the design | of engineering components, the evaluation of the | | | |
| mechanical and thermal stability of metal matrix composites, an | | | | |
| intermetallics in very-high temperature aircraft applications. De | eveloped functionally graded structures for superior | | | |
| thermal barrier coatings. Created advanced metals for multi-fur | ictional space systems. | | | |
| (U) In FY 2004: Expand experimental and modeling studies of mec | | | | |
| prediction, and lifetime assessment of composites, refractory me | | | | |
| moderate and very high temperatures. Continue developing adv | | | | |
| Explore scientific bases for computational design to reduce new | | | | |
| Develop new models to reduce new material maturity time and | 1 0 | | | |
| performance materials more affordably by integrating material of | | | | |
| (U) In FY 2005: Continue exploring and modeling metal matrix con | | | | |
| for applications at moderate and very high temperatures. Create | | | | |
| Enhance and broaden computational models by implementing s | | | | |
| Project 2306 | R-1 Shopping List - Item No. 1-24 of 1-48 | | Exhibit R-2a (P | 'E 0601102F) |

| | | Exhibit R- | 2a, RDT&E | | stification | | | DATE | | 2004 |
|-------------------|--|-------------------|-------------------|-------------------|---------------------------------|--------------------------|----------------|-----------------------------|--------------|--------------|
| | DGET ACTIVITY Basic Research | | | | PE NUMBER A | ND TITLE efense Resea | rch | PROJECT NUM 2306 Materia | | 2004 |
| ധ | time, assess/validate materials desig Total Cost | n codes, seek int | tegration with de | esign processes | , and minimize co | osts. | | 14.170 | 15.035 | 15.917 |
| . , | C. Other Program Funding Summ | nary (\$ in Milli | one) | | | | | 1 | 101000 | 100017 |
| (0) | <u>C. Other i rogram Funding Summ</u> | <u>FY 2003</u> | <u>FY 2004</u> | FY 2005 | FY 2006 | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> | Cost to | |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | Total Cost |
| (U) (U) (U) | PE 0602201F, Aerospace Flight Dynamics. PE 0602203F, Aerospace Propulsion. PE 0602500F, Multi-Disciplinary Space Technology. PE 0602601F, Space Technology. PE 0603211F, Aerospace Structures. PE 0708011F, Industrial Preparedness. | | | | | | | | | |
| Pro | oject 2306 | | F | R-1 Shopping List | - Item No. 1-25 of ² | 1-48 | | | Exhibit R-2a | PE 0601102F) |

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|---|---|--|--|--|---|--|--|--|---|--|
| BUDGET ACTIVITY 01 Basic Research | | | | o | PE NUMBER AND 1601102F Defe Sciences | o TITLE ense Researd | :h | PROJECT NUME 2307 Fluid M | | |
| Cost (\$ ir | Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | (WIIIIOIIS) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 2307 Fluid Mechanics | | 10.025 | 12.875 | 10.902 | 10.997 | 11.715 | 11.426 | | | 0.000 |
| Quantity of RDT& | E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) <u>A. Mission Descripti</u> Fluid mechanics basic space vehicles. The g used to expand curren on turbulence predicti formulate advanced curve vehicles and propulsio well as rotating and ir | research advances oals are to improve t flight performance on and control, unst omputational metho on systems. Primary | fundamental kn theoretical mod boundaries three eady and separa ds to: simulate v areas of resear | els for aerody ough enhanced ated flows, sub and study com ch investigated | namic predictio l understanding sonic/superson pplex flows; pre | on and design, a g of key fluid flo ic/hypersonic fl edict real gas ef | s well as to orig ow (primarily h lows, and interr fects in high-sp | ginate flow con igh-speed air) al fluid dynan eed flight; and | ntrol concepts a phenomena. B nics. The prima l control and pro | and predictive m asic research en ary approach is edict turbulence | nethods nphasis is to e in flight |
| (U) <u>B. Accomplishments/</u> (U) MAJOR THRUST: Cl knowledge of high-spe systems. | naracterize the critic | al phenomena i | • | • | - | | <u>FY</u> | <u>7 2003</u> 2.521 | <u>FY 2004</u> 2.760 | <u>FY 2005</u> 0.000 |
| (U) In FY 2003: Investigation(U) Unmanned aerial vehict flow situations occurring | es (UAVs). Investi | gated rapid mar | euver UAV ac | | | | | | | |
| (U) In FY 2004: Develop vortex-dominated flow associated with rapid n complex air vehicle an | s on the control and naneuver UAVs. Ev | flight performa | nce of UAVs. | Investigate aer | ro/structure inte | eractions | | | | |
| (U) In FY 2005: Not Appl unsteady aerodynamics | | | tivities will be | come part of th | e "supersonic, l | hypersonic, | | | | |
| (U) (U) MAJOR THRUST: In future Air Force trans- (U) In FY 2003: Developed Developed high-speed hypersonic flight vehic | atmospheric vehicles d supersonic flow co flow prediction code | s and flight cont ontrol concepts, | trol systems. including plas | sma and magne | to-hydrodynam | ic techniques. | | 2.999 | 3.163 | 0.000 |
| (U) In FY 2004: Examine | | rol concepts for | shock-domina | ted flows. Pur | sue aerotherma | l numerical | | | | |
| Project 2307 | | | R-1 SI | hopping List - Iter | m No. 1-26 of 1-4 | 8 | | | Exhibit R-2a (I | PE 0601102F) |

| | Exhibit R-2a, RDT&E Projec | DA | DATE February 2004 | | | |
|----------------------------------|---|--|-----------------------|-----------------|--------------|--|
| | T ACTIVITY sic Research | PROJECT NUMBER AND TITLE 2307 Fluid Mechanics | | | | |
| (U) In un | mulation capabilities to quantify heat transfer and unsteadiness for flight vel FY 2005: Not Applicable. Note: In FY 2005, these activities will become isteady aerodynamics" efforts later in this Project. | | | | | |
| to | AJOR THRUST: Investigate and characterize complex phenomena in supe enable and optimize the design of air and space vehicles and flight control s | | 0.000 | 0.000 | 4.912 | |
| | FY 2003: Not Applicable. | | | | | |
| | FY 2004: Not Applicable. | | | | | |
| un ch ae Ex ab ea | FY 2005: Explore methods to optimize unsteady, vortex-dominated flows manned aerial vehicles (UAVs). Model unsteady aerodynamics of complex maracterize hypersonic flows to include boundary layer effects, engine integr erothermal and local shock phenomena in hypersonic flows, control concepts splore control strategies for the mitigation of excessive heat transfer and unst boating the effects of highly separated flows. Note: Prior to FY 2005, these ac urlier in this Project. | x, configuration-induced flows and ration, and plasma aerodynamics. Model s, and performance optimization. steadiness in hypersonic flows and for | | | | |
| (U) | | | | | | |
| | AJOR THRUST: Explore fundamental knowledge of turbulence in coordin | | 2.521 | 2.760 | 0.000 | |
| | mulation efforts to enhance the performance, controllability, and stability in | | | | | |
| ree ve | FY 2003: Investigated new areas and methods of flow control on aircraft v duced order models for turbulent flow control applications and affordable en chicle design process. Assessed quality of promising flow control actuation vestigated flow control coupling mechanisms in turbulent flows to enable ag | ngineering predictive models for the air concepts on realistic geometries. | | | | |
| (U) In rec ve | FY 2004: Develop approaches for modeling unsteady flow control inputs of duced order models for turbulent flow control applications and affordable en chicle design process. Evaluate promising flow control actuation concepts of sts. Further investigations into flow control-coupling mechanisms in turbule | on aircraft wings and jet engines. Utilize ngineering predictive models for the air on realistic geometries in wind tunnel | | | | |
| (U) In | FY 2005: Not Applicable. Note: In FY 2005, these activities will become ows" efforts later in this Project. | | | | | |
| (U) | · | | | | | |
| (U) M | AJOR THRUST: Study complex rotating and internal flow characteristics populations. | related to turbomachinery and jet engine | 1.984 | 2.209 | 0.000 | |
| · · | FY 2003: Evaluated unsteady flow phenomena and enhanced the understand | nding of forcing modes in | | | | |
| tu | rbomachinery to predict and avoid high cycle and thermal failures in jet eng ldy simulation techniques to explore complex gas turbine engine flow fields | ines. Investigated application of large | | | | |
| Project | t 2307 R-1 Shoppir | ng List - Item No. 1-27 of 1-48 | | Exhibit R-2a (F | PE 0601102F) | |

| Exhibit F | DATE | DATE February 2004 | | | | | | |
|--|--|---|---|--|-----------------|-----------------|-----------------|-------------------|
| BUDGET ACTIVITY 01 Basic Research | PROJECT NUME 2307 Fluid M | | | | | | | |
| flow control measurement and actuation devices for (U) In FY 2004: Explore coupling mechanisms in mu forcing modes in turbomachinery and to predict hi techniques to explore heat transfer and fluid flow or interactions using flow control measurement and a (U) In FY 2005: Not Applicable. Note: In FY 2005, to | ltiple blade row in gh cycle fatigue f coupling in turbin actuation devices f | nteractions in ord ailures in jet eng e engine flow fie for use in harsh e | ines. Use large elds. Investigate environments. | eddy simulation detailed flow | | | | |
| flows" efforts later in this Project. | | n oooono part o | | and forming | | | | |
| (U) (U) MAJOR THRUST: Expand fundamental knowled simulation efforts. Study complex rotating and int applications. | - | | - | - | | 0.000 | 0.000 | 5.990 |
| (U) In FY 2003: Not Applicable. | | | | | | | | |
| (U) In FY 2004: Not Applicable.(U) In FY 2005: Evaluate validation studies of advance | 1.01 / 1 | 1. 1 | | | | | | |
| eddy simulation techniques to probe heat transfer a wings and jet engines to include reduced order, clo mistuning mechanisms in multiple blade row inter | and fluid flow cou osed-loop flow co actions tied to hig | ipling. Model un ntrol demonstrat gh cycle fatigue f | nsteady flow con ions. Explore ac ailures. Investig | trol inputs on erodynamic gate detailed flow | - | | | |
| interactions using flow control measurements and | | | | d tunnel tests. | | | | |
| Note: Prior to FY 2005, these activities were cover (U) | red under other el | forts earlier in tr | iis Project. | | | | | |
| (U) CONGRESSIONAL ADD: National Hypersonic | Research Center. | | | | | 0.000 | 1.983 | 0.000 |
| (U) In FY 2003: Not Applicable. | | | | | | | | |
| (U) In FY 2004: Conduct fundamental scientific and e Center. | engineering resear | rch studies at the | National Hyper | sonics Research | | | | |
| (U) In FY 2005: Not Applicable. | | | | | | 10.005 | 10.075 | 10.000 |
| (U) Total Cost | | | | | | 10.025 | 12.875 | 10.902 |
| (U) <u>C. Other Program Funding Summary (\$ in Mil</u> | <u>llions)</u> | | | | | | | |
| <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> | Cost to | <u>Total Cost</u> |
| Actual(U)Related Activities:(U)PE 0602102F, Materials.(U)PE 0602201F, Aerospace Flight(U)D | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Complete</u> | |
| Dynamics. | | | | | | | | |

| Exhibit R-2a, RDT& | DATE February 2004 | |
|--|--|------------------------------|
| BUDGET ACTIVITY D1 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | T CONTRACT 2004 |
| (U) C. Other Program Funding Summary (\$ in Millions) PE 0602203F, Aerospace Propulsion. PE 0603211F, Aerospace Structures. (U) D. Acquisition Strategy Not Applicable. | | |
| Project 2307 | R-1 Shopping List - Item No. 1-29 of 1-48 29 | Exhibit R-2a (PE 0601102 |

| | Ex | hibit R-2a, F | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|-------------------|---|---|---|---|--|---|---|--|---|---|
| | GET ACTIVITY Basic Research | | | Q | PE NUMBER AND 1601102F Defe Sciences | | :h | PROJECT NUM 2308 Propuls | BER AND TITLE sion | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 2308 | | 22.554 | 15.660 | 15.864 | 16.918 | 17.791 | 17.675 | | | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) | A. Mission Description and Budget Ite Propulsion basic research expounds fund rockets, and combined cycle propulsion s power and propulsion, high altitude signa the synthesis of new chemical propellant coupling between energy release through research includes both plasma and beame areas of research investigated by this pro- | amental knowled systems for futur ature characteriza s. These thrusts chemical reaction ed-energy propul | e rapid global ation and conta can be groupe on and the flow sion for orbit 1 | reach and on-d amination, prop d into reacting v processes tha raising space m | lemand space ac pulsion diagnost flows and non- t transport chen hissions and ultr | ccess. Basic rest tics, thermal ma chemical energe nical reactants, a-high energy t | earch thrusts is anagement of s etics. Study o products, and | include airbreat space-based por f reacting flows energy. Non-c | thing propulsion wer and propuls s involves the co hemical energet | n, space sion, and omplex tics |
| (U) (U) (U) | B. Accomplishments/Planned Program MAJOR THRUST: Study methods for en and space vehicles. In FY 2003: Expanded research studies to aerodynamic characteristics and propulsiv Investigated plasma control effects and ev plasma effects on lowering fuel consumpti generation, and alleviating sonic boom and In FY 2004: Not Applicable. Note: In F [*] power" efforts in this Project. In FY 2005: Not Applicable. | abling and impro develop a soun e efficiencies so aluated means to ion, improving p d engine noise. | d scientific bas as to enhance engineer then ropulsion syste | sis for plasma u hypersonic veh n into operation em performanc | ntilization to imp nicle range by n nal systems. In re, providing on | prove nore than 10%. vestigated -board power | <u>F</u> 3 | <u>7 2003</u> 2.022 | <u>FY 2004</u> 0.000 | <u>FY 2005</u> 0.000 |
| (U) | MAJOR THRUST: Research and model a miniaturization, and contamination/signate In FY 2003: Studied means to improve th constellations of cooperating micro-satelli to increase payload and thrust. Studied the for self-consuming satellites. Researched combined cycle engines. Created advance enhance the design of new engines. Researched | ure. rust and control tes. Expanded the feasibility of en- new engine con- ed supercritical c | of propulsion the understandi access silicon as propulsion as p ombustion mo | systems to deve ng of mechanic s a space prope pulsed detonatic dels and levera | elop high-precis cal-electric ener ellant in develop on engines, hybridge computation | sion gy conversion ving concepts rid rockets, and al capability to | | 6.915 | 6.700 | 7.923 |
| Proj | ject 2308 | | R-1 SI | hopping List - Iter | m No. 1-30 of 1-4 | 8 | | | Exhibit R-2a (I | PE 0601102F) |

| Exhibit R-2a, RDT&E Pro | ject Justification | DATE February 2004 | | |
|---|---|-----------------------|--|--------------|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | | PROJECT NUMBER AND TITLE 2308 Propulsion | |
| develop a new class of more versatile plasma thrusters. (U) In FY 2004: Study micro-chemical, plasma-based, and beamed-energy baimpulse, and control of propulsion systems for high-precision constellation enhance decisive awareness of threats and opportunities. Further research detonation engines, hybrid rockets, and combined cycle engines. Advance leverage computational capabilities that will enhance the design of new hymonopropellant-fueled engines. Complete research of plasma turbulence in order to develop a new class of more versatile plasma thrusters. Resear and spacecraft cross-contamination, especially in the presence of multiple magnetohydrodynamic (MHD) flow control to optimize propulsion system. Investigate lightweight super conducting magnet capability for onboard fl flow control of advanced engines. Investigate plasma ignition approaches stability in scramjets and high altitude subsonic airbreathing propulsion system. U) In FY 2005: Expand studies in plasma-based, charged droplet-based (coll new engine concepts such as pulsed detonation rocket engines. Evaluate to the engines. | ns of cooperating micro-satellites in order to into new engine concepts such as pulsed e supercritical combustion models and ydrocarbon, cryogenic, and and its effects on the transport coefficients rch high altitude signature characterization thrusters and satellites. Examine n flow path performance in scramjets. ight-rated systems needed to achieve MHD s to improve combustion efficiency and vstems. lide), and beamed-energy thrusters. Explore unsteady flow coupling and plasma ignition | | | |
| combustion efficiencies and stability. Investigate high altitude signature c cross-contamination. Examine MHD flow control to optimize scramjet flo lightweight superconducting magnet capability for MHD flow control of a plasma activities in this effort will be moved to the "combustion, propulsion". | ow path performance. Investigate advanced engines. Note: In FY 2005, the | | | |
| (U) (U) MAJOR THRUST: Study diagnostics and data reduction analyses. (U) In FY 2003: Completed studies of advanced diagnostics systems for data concepts for novel propulsion system applications. Completed study of la spectroscopic measurements in relation to infrared and ultraviolet excitation | ser-induced fluorescence and absorption | 4.491 | 0.000 | 0.000 |
| (U) In FY 2004: Not Applicable. Note: In FY 2004, these activities will be a diagnostics" efforts in this Project. (U) In FY 2005: Not Applicable. (U) | | | | |
| (U) MAJOR THRUST: Explore combustion, propulsion, and diagnostics in s Investigate multi-phase, turbulent reacting flows to improve the performan turbines, ramjets, scramjets, pulsed detonation engines, and rockets. (U) In FY 2003: Developed enhanced computer models that predict unsteady Advanced the state of large eddy simulation methods for turbulent hydroc upgraded subgrid-scale models for chemistry and fuel droplets. | nce of propulsion systems, including gas behavior, such as combustion instability. | 6.626 | 6.432 | 7.941 |
| Project 2308 R-1 Sho | opping List - Item No. 1-31 of 1-48 | | Exhibit R-2a (F | PE 0601102F) |

| Exhibit R-2a, RDT8 | TIVITY PE NUMBER AND TITLE 06011027 Defense Research Sciences PROJECT NUMBER 2303 Propulsion 2004: Improve laser diagnostic measurement capabilities with expanded agility over limited wavelength ranges ne-resolved characterization of reacting flows. Develop detailed mechanisms for hydrocarbon fuel combustion rated pressures. Explore scientific basis for how plasmas are used to improve aerodynamic characteristics and lsive efficiencies. PROJECT NUMBER 2005: Improve laser diagnostic measurement capabilities in the characterization of reacting flows. Probe ultar transport effects causing and enhancing thermal destabilization of hydrocarbon fuel someters and ulat transport effects causing and enhancing thermal destabilization of hydrocarbon fuels under supercritical odynamic conditions. Incorporate prediction methodologies, which are both quantitatively accurate and utationally tractable, into turbulent combustion models. Enhance scientific bases for how plasmas are used to we aerodynamic characteristics and propulsive efficiencies. Identify and evaluate fuels and propellants that are energetic, environmentally benign, and less sensitive to accidental detonations. 2.500 2003: Produced limited quantities (50 gallons) of coal-derived fuel for large-scale combustion, fuel system g, and ignition experiments. Furthered investigations for coal-derived fuel production scale-up. 2004: Produce coal-based pi fuels in increasingly larger quantities through refinery trials. Evaluate refinery ced fuels for large-scale combustion and thermal stability. 22.554 ther Program Funding Summary (S in Millions) EY 2005 EY 2006 EY 2007 EY 2008 Ey 2009 Extimate Estimate | | | Exhibit R-2a, RDT&E Project Justification February 2004 | | | | 2004 |
|--|---|---|-----|---|-----------------------------------|-------------------|--|------|
| BUDGET ACTIVITY 01 Basic Research | 0601102 | F Defense Research | | | | | | |
| for time-resolved characterization of reacting flows. Develop det at elevated pressures. Explore scientific basis for how plasmas at propulsive efficiencies. (U) In FY 2005: Improve laser diagnostic measurement capabilities molecular transport effects causing and enhancing thermal destat thermodynamic conditions. Incorporate prediction methodologie computationally tractable, into turbulent combustion models. En improve aerodynamic characteristics and propulsive efficiencies. | tailed mechanisms for hydrocat re used to improve aerodynami in the characterization of reacti- bilization of hydrocarbon fuels s, which are both quantitatively hance scientific bases for how Identify and evaluate fuels an | bon fuel combustion c characteristics and ng flows. Probe under supercritical y accurate and plasmas are used to | | | | | | |
| (U) CONGRESSIONAL ADD: Coal-derived Jet Fuels. (U) In FY 2003: Produced limited quantities (50 gallons) of coal-der fouling, and ignition experiments. Furthered investigations for comparison of the second sec | cal-derived fuel production sca | le-up. | 2. | 500 | 2.528 | 0.000 | | |
| (U) Total Cost | | | 22. | 554 | 15.660 | 15.864 | | |
| <u>FY 2003</u> <u>FY 2004</u> | | | | | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> | | |
| Project 2308 | R-1 Shopping List - Item No. 1-3 | 2 of 1-48 | | | Exhibit R-2a (| PE 0601102F) | | |

| Exhibit R-2a, RDT | &E Project Justification | DATE February 2004 |
|---|--|---------------------------------|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | T NUMBER AND TITLE ropulsion |
| (U) D. Acquisition Strategy Not Applicable. | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Project 2308 | R-1 Shopping List - Item No. 1-33 of 1-48 | Exhibit R-2a (PE 0601102F) |

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 | |
|---|--|--|---|---|--|---|---|--|---|--|--|
| BUDGET ACTIVITY 01 Basic Research | | | PE NUMBER AND TITLE 0601102F Defense Research Sciences | | | | :h | | February 2004 PROJECT NUMBER AND TITLE 311 Space and Information Sciences | | |
| Со | st (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total | |
| 2311 Space and In | formation Sciences | 14.681 | 20.379 | 24.661 | 23.286 | 22.523 | 22.868 | 23.660 | 0.000 | 0.000 | |
| | RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| Element will be move | e Project name, "Space Sc d to this Project. Ecription and Budget Iter | C | ed to "Space an | d Information 3 | Sciences." Add | litionally, in FY | 7 2005, some a | activities in Pro | ject 2304 of thi | s Program | |
| near-Earth orbit flares, cosmic r activity with the order to enhanc of this program | mation sciences basic rese , geosynchronous orbit, an ays, and geomagnetic storn e deposition of energy at the e the effectiveness of Air 1 are solar phenomena and n the information sciences ion. | nd deep space. ms. Focus is on ne Earth. Metho Force global do weather; magne | The goal is to e a specifying the ods are develop minance throug etospheric and i | enable greater, e flow of mass, bed to forecast gh space operat ionospheric eff | more cost-affor momentum, an the turbulent pla- tions. The prim tects; space debu | dable, protection d energy throug asma phenoment ary areas of res- is studies; and | on of space ass gh space to de na that mediate search investig innovative spa | sets from space velop a global r e the flow of en gated by the spa- ace-based comm | debris, solar wi nodel that conn ergy through sp ce environment nunications. Th | ind, solar ects solar pace in portion ne primary | |
| (U) MAJOR THRUS protection of Ain (U) In FY 2003: Ob for enhanced pre- more robust desi Technology Sola physics, solar os solar magnetic fi Force space oper (U) In FY 2004: Exp ejections. Suppor Telescope. Conta solar magnetic fi | nents/Planned Program (T: Analyze solar physics Force space assets and op served and analyzed solar diction of large-scale, higl gns. Explored technology r Telescope to exploit ada cillation modes, solar flare eld complexity to enable f ations. bloit solar physics models ort cutting-edge instrument inue investigating solar fla eld complexity through su overnment teams managing | and weather to be an erations. phenomena to con- energy plasma requirements to ptive optics tech s, coronal mass forecasting of so to develop tech tation developman ares, coronal mass pport of ground | characterize and a ejections to de o enable develo hniques. Expan e ejections, mag olar eruptions a niques for proto thent for the grou ass ejections, m l-based optical | d model the phy evelop protection opment of a new inded the investignetic reconnect and predict environ ecting assets ago und-based Adviron agnetic reconniand radio solar | ysics of solar m ve spacecraft st w ground-based igation of solar tion in space pl ronmental risks gainst high-ener anced Technolo ection in space observatories, | agnetic fields ructures and Advanced dynamo asmas, and to critical Air gy plasma ogy Solar plasmas, and as well as | ΕY | <u>7 2003</u> 3.714 | <u>FY 2004</u> 3.628 | <u>FY 2005</u> 0.000 | |
| - | to model and simulate the computational architecture | - | | | y capability with n No. 1-34 of 1-48 | | | | Exhibit R-2a (| PE 0601102F) | |

| Exhibit R-2a, RDT&E Project | DAT | DATE February 2004 | | | | | |
|--|--|---|-----------------|-------|--|--|--|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | PROJECT NUMBER AND TITLE 2311 Space and Information So | | | | | |
| (U) In FY 2005: Not Applicable. Note: In FY 2005, these activities will be conse | olidated into "Space Environment | | | | | | |
| Research" efforts later in this Project. | | | | | | | |
| (U)(U) MAJOR THRUST: Research magnetosphere and ionosphere effects to enhan communication. | ace global surveillance, geolocation, and | 3.714 | 3.628 | 0.000 | | | |
| (U) In FY 2003: Developed mitigation techniques for ionospheric scintillation and enhance global surveillance, geolocation, and communication. Supported scie ground-based data assimilation techniques to modernize ionospheric and space atmospheric gravity wave interactions from high and low geomagnetic latitude using radars, advanced electro-optical instrumentation, and light detection and seasonal and climatic models of ionospheric phenomena. | entific analysis of space-based and e weather forecasting. Observed es, as well as tropical observation sites, | | | | | | |
| (U) In FY 2004: Expand deployment of research sensors to observe ionospheric s turbulence radio disruptions. Support scientific analyses of space-based and g techniques to modernize ionospheric and space weather forecasting. Design a globally to improve capability to observe atmospheric gravity wave interaction instrumentation, and light detection and ranging techniques. Exploit cutting-e optics to obtain sensitive infrared observations of ionospheric plasma physics, clutter. | ground-based data assimilation and examine observational equipment ns with radars, advance electro-optical edge developments in all-sky imaging | | | | | | |
| (U) In FY 2005: Not Applicable. Note: In FY 2005, these activities will be conse Research" efforts later in this Project. | olidated into "Space Environment | | | | | | |
| | | 4.01.5 | 1 210 | 0.000 | | | |
| (U) MAJOR THRUST: Research, characterize, and model space debris to protect (U) In FY 2003: Improved the cataloging and tracking the populations of Near Ea particles derived from comets and asteroids. Explored laser guide-star develop as ballistic and orbital targets. Developed advanced astronomical instrumenta include laser ranging and adaptive optics for deep space surveillance. Began s astronomical detection and tracking algorithms for enhancement of DoD surve observational campaigns to characterize the aerodynamic drag, turbulence, and that degrade DoD targeting. | arth Objects (NEOs) and space debris opment for observations of NEOs, as well ation and observational methods to studies into the developments in eillance capabilities, and support | 4.215 | 4.310 | 0.000 | | | |
| (U) In FY 2004: Continue efforts to catalog and track the populations of Near Spa particles derived from comets and asteroids. Advance multi-conjugate adaptiv small, dim, deep space targets. Further developments in astronomical detection space awareness and control capabilities. Expand development of future space nanotechnology and advanced signal processing algorithms. | ve optics for unparalleled resolution of on and tracking algorithms to enhance | | | | | | |
| Project 2311 R-1 Shoppir | ng List - Item No. 1-35 of 1-48 | | Exhibit R-2a (F | | | | |

| Exhibit R-2a, RDT&E P | DA | DATE February 2004 | | | |
|--|---|-----------------------|--|--------------|--|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | | PROJECT NUMBER AND TITLE 2311 Space and Information Sci | | |
| (U) In FY 2005: Not Applicable. Note: In FY 2005, these activities will I | be consolidated into "Space Environment | | | | |
| Research" efforts later in this Project. | | | | | |
| (U) (U) MAJOR THRUST: Expand theories for the development of physics-t through advancements in multi-conjugate adaptive optics, and the qua | | 3.038 | 2.954 | 0.000 | |
| (U) In FY 2003: Provided support to the Air Force's Communications/Nav Ejection Imager satellite missions. Investigated the theoretical underp environment and charged particle remediation techniques. Investigate space by energetic charged particles from deep space and by cosmic ra- space by energetic charged particles from deep space and by cosmic ra- space by energetic charged particles from deep space and by cosmic ra- space by energetic charged particles from deep space and by cosmic ra- space by energetic charged particles from deep space and by cosmic ra- space by energetic charged particles from deep space and by cosmic ra- space by energetic charged particles from deep space and by cosmic ra- space by energetic charged particles from deep space and by cosmic ra- space by energetic charged particles from deep space and by cosmic ra- space by energetic charged particles from deep space and by cosmic ra- space by energetic charged particles from deep space and by cosmic ra- space by energetic charged particles from deep space and by cosmic ra- space by energetic charged particles from deep space and by cosmic ra- space by energetic charged particles from deep space and by cosmic ra- space by energy of the space and by cosmic ra- space by energy of the space and by cosmic ra- space by energy of the space and by cosmic ra- space by energy of the space and by cosmic ra- space by energy of the space and by t | vigation Outage Forecast System and Solar Mass binnings of robust antenna designs for the space ed the variable energy deposited in near-Earth | | | | |
| (U) In FY 2004: Create new space environment models and enhance curr Communications/Navigation Outage Forecasting System and Solar M investigating the theoretical underpinnings of active and passive space Stimulate novel efforts to advance design, study, and development new and energetic charged particles from deep space in order to better quan simulation and visualization techniques to simplify complex data anal | ent theories using data from the Air Force's (ass Ejection Imager satellite missions. Continue e environment remediation techniques. w sensor technologies to observe cosmic rays ntify risks to Air Force systems. Research | | | | |
| (U) In FY 2005: Not Applicable. Note: In FY 2005, these activities will Research" efforts later in this Project. | be consolidated into "Space Environment | | | | |
| (U) | | | | | |
| (U) MAJOR THRUST: Research space environment to improve solar the phenomena and weather, magneto/ionosphere effects, space debris, ad better space-based communications, and the quantifying of risks to space. | laptive optics for improved space observation, | 0.000 | 0.000 | 8.463 | |
| (U) In FY 2003: Not Applicable. | , , | | | | |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Exploit astronomical detection, tracking, and cataloging surveillance capability in conjunction with data from the Communicat Solar Mass Ejection Imager satellites. Support development of ground adaptive optics systems, light detection and ranging radars, nanotechn algorithms. Refine forecasting of ionosphere and space environment of imaging and multiconjugate adaptive optics to obtain infrared observat waves, dynamics, optical clutter and small, dim, deep space targets. C ejections, magnetic reconnection in space plasmas, and solar magnetic these activities were part of other efforts earlier in this Project. | tions/Navigation Outage Forecasting System and d-based advanced technology solar telescope tology, and advanced signal-processing effects. Exploit developments in all-sky ations of ionospheric plasma physics, gravity Continue investigating solar flares, coronal mass | | | | |
| (U) | | | | | |
| (U) MAJOR THRUST: Investigate innovative technologies for space-bas | - | 0.000 | 1.000 | 1.000 | |
| Project 2311 R-1 | 1 Shopping List - Item No. 1-36 of 1-48 | | Exhibit R-2a (| PE 0601102F) | |

| Exhibit R-2a, RDT&E | DA | DATE February 2004 | | |
|---|---|-----------------------|------------------------------------|--------------|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | | IMBER AND TITLE e and Informati | on Sciences |
| continued Air Force space dominance. (U) In FY 2003: Not Applicable. Note: This is a new thrust area for FY (U) In FY 2004: Research innovative methods for optical communication bandwidth efficient modulation to enhance satellite communications polarization antennas for space applications. (U) In FY 2005: Examine innovative methods for optical communication bandwidth efficient modulation to enhance satellite communication bandwidth efficient modulation to enhance satellite communication bandwidth efficient modulation to enhance satellite communications polarization antennas for space applications. | ons. Begin probing novel techniques for potential s. Start exploring the basic mechanisms of dual ons. Probe novel techniques for potential | | | |
| (U) (U) MAJOR THRUST: Investigate signal communications, surveillance improved command and control for the battlefield commander. Effore generalized functions and probability, harmonic methods, and asympticativities were covered under Project 2304 in this Program Element. (U) In FY 2003: Not Applicable. | orts include research in linear operator theory, aptotic expansions. Note: Prior to FY 2005, these | 0.000 | 0.000 | 4.211 |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Improve data fusion science to permit rapid data convector conceptualized information. Promote methodologies to evaluate the communications systems. Assess technical alternatives on the overal search and rescue imagery. Solidify the hybrid radio-frequency/free of other innovative technologies to attain ultra-fast, reliable information transmission of hyperspectral and other diverse data. | e performance of new wireless mobile, networked all feasibility of super-resolution millimeter and e-space optical paradigm and refine the parameters | | | |
| (U) (U) MAJOR THRUST: Conduct research in complex systems and algor information systems supporting battlefield commanders using artific agents, knowledge bases, distributed systems, machine learning, unc information assurance, and information fusion. Note: Prior to FY 2 2304 in this Program Element. | cial intelligence, information warfare, intelligent certainty reasoning, and artificial intelligence, | 0.000 | 0.000 | 10.987 |
| (U) In FY 2003: Not Applicable. | | | | |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Continue research in information assurance for protect networks. Develop information fusion to provide deep, adaptive, ex computer devices and algorithms to allow enhanced tracking, recogn command and control. Design, implement, and evaluate quantum-co of complex fluid dynamics. | xpert decision support. Construct quantum nition, and characterization to improve awareness, | | | |
| | R-1 Shopping List - Item No. 1-37 of 1-48 | | Exhibit R-2a (| PF 0601102F) |

| Exhibit R | -2a, RDT&E | Project Jus | stification | | | | DATE February | / 2004 |
|--|---|---------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|----------------------|---|-------------------|
| BUDGET ACTIVITY 01 Basic Research | | PE NUMBER A 0601102F D Sciences | ND TITLE efense Resea | rch | | T NUMBER AND TITLE | | |
| (U) (U) CONGRESSIONAL ADD: Chabot Space and Scie (U) In FY 2003: Not Applicable. | | | | | | 0.000 | 1.983 | 0.000 |
| (U) In FY 2004: Support the development of astronom Chabot Space and Science Center. (U) In FY 2005: Not Applicable. (U) | ical and scientifi | c research and e | ducation capabil | ities at the | | | | |
| (U) CONGRESSIONAL ADD: Quantum Information (U) In FY 2003: Not Applicable. (U) In FY 2004: Conduct fundamental scientific resear (U) In FY 2005: Not Applicable. | | th quantum info | rmation technolo | ogies. | | 0.000 | 1.091 | 0.000 |
| (U) (U) CONGRESSIONAL ADD: Information Security a (U) In FY 2003: Not Applicable. (U) In FY 2004: Conduct fundamental scientific studie | | | and cyber count | er terrorism. | | 0.000 | 1.785 | 0.000 |
| (U) In FY 2005: Not Applicable.(U) Total Cost | | | | | | 14.681 | 20.379 | 24.661 |
| (U) <u>C. Other Program Funding Summary (\$ in Mill</u> <u>FY 2003</u> <u>Actual</u> | <u>ions)</u> <u>FY 2004</u> <u>Estimate</u> | FY 2005 Estimate | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2</u> Estir | 2009 <u>Cost to</u> mate <u>Complete</u> | <u>Total Cost</u> |
| (U) Related Activities: PE 0602500F, | | | | | | | | |
| (U) Multi-Disciplinary Space Technology. PE 0602601F, Space | | | | | | | | |
| (U) Technology. (U) PE 0602702F, Command, (U) Review of the second sec | | | | | | | | |
| PE 0603410F, Space System | | | | | | | | |
| (U) Environmental Interactions Technology. (U) PE 0603500F, Multi-Disciplinary Advanced | | | | | | | | |
| Project 2311 | F | R-1 Shopping List | - Item No. 1-38 of 7 | 1-48 | | | Exhibit R-2a | (PE 0601102F) |

| Exhibit R-2a, RDT&E P | roject Justification | DATE February 2004 |
|--|---|--|
| BUDGET ACTIVITY 01 Basic Research | | PROJECT NUMBER AND TITLE 2311 Space and Information Sciences |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Development Space Technology. | | |
| (U) D. Acquisition Strategy Not Applicable. | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Project 2311 R-1 | Shopping List - Item No. 1-39 of 1-48 39 | Exhibit R-2a (PE 0601102F) |

| | Ext | nibit R-2a, I | RDT&E Pro | ject Justi | ication | | | DATE | February | 2004 |
|--------------------------------------|----------------------------|---------------|-----------|------------|--|----------|----------|------------------------------|-------------------------------|-------|
| BUDGET ACTIVITY 01 Basic Research | | | | | PE NUMBER AND D601102F Defe Sciences | | | PROJECT NUMI 2312 Biologi | BER AND TITLE cal Sciences | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| 2212 | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | 0.000 |
| 2312 | Biological Sciences | 13.605 | 9.272 | 9.631 | 9.756 | 13.443 | 10.279 | 10.526 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

(U) A. Mission Description and Budget Item Justification

Biological basic science research provides the fundamental knowledge necessary to understand and enable technologies associated with chemical and physical agent toxicity, electromagnetic sensors based on biomimicry, biomolecular materials, biochromatics, and luminescence. The goal is to exploit biological properties to control and manipulate operational environments. Research topics in toxicology explore the interaction of Air Force chemicals and physical agents (lasers and microwaves) with human tissues and associated effects to enable safety assessment strategies to ensure the hazard-free development and use of future air and space materials and directed energy systems. Research in biomimetic sensors strives to mimic the biological detection systems of organisms at the molecular level in developing novel man-made sensors. Basic research in biomaterials focuses on the mimicking of natural materials, using organisms as biomaterial factories of new materials, genetically altering existing organisms for new materials capabilities, or taking existing biomaterials/organisms and using them as novel materials like viral gradients or processing them further to make a useful material as in biominerialization. Research in biointerfacial science is focused on new biosensors and bionanotechnology, and specifically addresses the fundamental science at either the biotic-biotic or the biotic-abiotic interface. The primary areas of research investigated by this project are bio-informatics, profiling, and response; biocatalysis and bioenzymatic properties; and biomimetic, biomaterials, and biointerfacial sciences.

(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>

Project 2312

- (U) MAJOR THRUST: Investigate natural response profiling and assessment from exposure to fuels, chemicals, and directed energy systems. Probe biocatalysis and bioenzymatic properties to characterize and modify enzymes as affordable and efficient catalysts in the manufacture of air and space materials.
- (U) In FY 2003: Identified organ-specific molecular pathways altered by JP-8 jet fuel exposures and evaluated various biomolecular indicators and mediators of the toxic response for use as potential biomarkers of human exposure and to enable the development of protective strategies. Explored mechanisms and commenced developing novel molecular descriptors that will help integrate in vitro toxicity data into a mathematical format for use in the rapid computational prediction of toxicity of air and space chemicals and new forms of directed energies. Investigated the biological effects of chronic low-level exposures to directed energy by profiling and modeling intracellular molecular responses and commenced identifying potentially harmful extra-cellular mediators.
- (U) In FY 2004: Continue a biokinetics study of the uptake, biodistribution, metabolism, and elimination of JP-8 fuel in animals exposed through the inhalation and skin routes as a first step in assessing the risks of jet fuels. Extend research on molecular descriptors and mathematical expression of in vitro toxicity data to include data from genomics and proteomics profiles to rapidly predict computationally the toxicity of air and space chemicals. Extend sensitive genomics and proteomics profiling techniques to studies investigating the cellular and extra cellular effects of chronic

R-1 Shopping List - Item No. 1-40 of 1-48

FY 2004

6.912

FY 2005

5.568

FY 2003

6.136

| Exhibit R-2a, RDT&E P | roject Justification | DA | February | 2004 |
|--|---|-------|--------------------------|-------|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | | MBER AND TITLE | |
| and acute low-level exposures of animals to laser and microwave systel bioenzymatic" activities were moved from another effort later in this P (U) In FY 2005: Model risks associated with exposure to fuels and complet biodistribution of JP-8 jet fuel components. Continue exploring, profil methodologies. Characterize, parameterize, and codify enzymes, proteenable and enhance efficiencies in the synthesis and processing of futu (U) (U) MAJOR THRUST: Evaluate biocatalysis and bioenzymatic properties catalysts in the processing and manufacturing of air and space material (U) In FY 2003: Furthered the essential and fundamental process of enzymodified the natural biocatalytic potential of enzymes to meet various extending substrate ranges and specificities or altering reaction rates. It techniques for maintaining or enhancing reaction rates during large-sca (U) In FY 2004: Not Applicable. Note: In FY 2004, these activities were and assessment" efforts earlier in this Project. (U) In FY 2005: Not Applicable. | roject to this effort. ex mixtures. Analyze the biokinetics and ling, and modeling bio-informatics eins, biocatalysts, and bio-energetic agents to re air and space materials. to characterize, modify, and utilize enzymes as s. ne discovery and characterization. Genetically synthetic manufacturing requirements by Explored alternative metabolic engineering ale production. | 3.661 | 0.000 | 0.000 |
| (U) MAJOR THRUST: Model chronobiology (biophysical and neural) met performance under conditions of sleep loss, sustained operations, and neural) in FY 2003: Investigated the biophysical mechanisms responsible for non-standard duty cycles and in adapting to jet lag. Explored mathemat the effects of wake-promoting countermeasures on the homeostatic and to predict specific deficits in human performance under conditions of s the phenotypic differences that enable some individuals to maintain hig performance under sleep deprivation. Note: In FY 2003, the vast major completed, so this separate focus was closed. (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. | non-standard sleep/wake duty cycles. crew fatigue in sustained operations or in atical models of sleep/wake dynamics, including d circadian systems, and extended these models leep loss. Conducted new research to identify ghly accurate cognitive and psychmotor | 2.051 | 0.000 | 0.000 |
| (U) (U) MAJOR THRUST: Explore biomimetics, biomaterials, and biointerfa sensors, engineering processes and mechanisms, and the synthesis of n (U) In FY 2003: Enhanced modeling of the fundamental principles, process biosystems at the sub-cellular, molecular and genomic levels to enable devices, and systems with enhanced structural and functional capabilit | ovel materials. sses, and designs of infrared sensitive the further development of infrared materials, | 1.757 | 2.360 Exhibit R-2a (F | 4.063 |

| Exhibit R-2a, RDT&E Project Justification | | | | | | | | DATE | DATE February 2004 | | |
|---|---|--|-----------------------------------|---|--|-----------------------------------|-----------------------------------|---|-----------------------|-------------------|--|
| BUDGET ACTIVITY 01 Basic Research | | | | | PE NUMBER AND TITLE 0601102F Defense Research Sciences | | | PROJECT NUMBER AND TITLE 2312 Biological Sciences | | | |
| | alternative biomimetic, near ambier alternative sensors for time-respons biophotoluminescent characteristics systems. | e characteristics. s in microbial and | Commenced a protein-based | dapting biochron biosystems for a | nophores and pplications to m | ilitary sensor | | | | | |
| | J) In FY 2004: Model the fundamental principles, processes, and designs of non-cryogenic infrared sensitive biosystems at the sub-cellular and molecular levels to enable future infrared materials, devices, and systems with enhanced structural and functional capabilities to identify, model, and construct near ambient infrared sensing devices. Continue adapting characteristics of microbial and protein-based biosystems for applications to military sensor systems. Explore mimicking natural materials, using organisms as factories of new materials, or taking existing biomaterials and processing them into Air Force useful materials. Study the fundamental science and nano surface structure of biomaterials for application to military sensor systems that will ensure reliable assessment and monitoring. | | | | | | | | | | |
| (U) | In FY 2005: Investigate, evaluate, a infrared devices. Explore biochrom biosystems for applications to milit novel materials, evaluate biosensors | nophores and biop ary sensor system | photoluminescents. Exploit bion | nt characteristics naterial and bioi | s in microbial an | d protein-based | | | | | |
| (U) | Total Cost | | | | | | | 13.605 | 9.272 | 9.631 | |
| (U) (U) (U) (U) (U) (U) (U) | C. Other Program Funding Summ Related Activities: PE 0602202F, Human Effectiveness Applied Research. PE 0602204F, Aerospace Sensors. PE 0602602F, Conventional Munitions. PE 0602702F, Command, Control, and Communication. D. Acquisition Strategy Not Applicable. | <u>mary (\$ in Mund</u> <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | Cost to Complete | <u>Fotal Cost</u> | |
| Pro | ject 2312 | R-1 Shopping List - Item No. 1-42 of 1-48 | | | | | Exhibit R-2a (PE 0601102F) | | | | |

| | Ext | nibit R-2a, I | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|--------------------------------------|----------------------------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---|---------------------|-------|
| BUDGET ACTIVITY 01 Basic Research | | | | C | - | | | PROJECT NUMBER AND TITLE 2313 Human Performance | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| 2313 | Human Performance | 12.332 | 12.667 | 13.596 | 13.655 | 14.412 | 14.105 | 14.319 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

(U) A. Mission Description and Budget Item Justification

Human performance basic research provides the fundamental knowledge necessary to examine and exploit all aspects of human information processing critical to Air Force operations. The goal is to develop useful quantitative models of the way warfighters perceive, appraise, and manipulate their environment; make decisions in complex tasks under stress or uncertainty; and adapt to extreme sensory, biophysical, or cognitive workloads. Sensory research emphasizes visual, auditory, equilibrium, and kinesthetic systems and their optimal integration. Basic research topics focus investigations on the scientific foundation for several developing Air Force technologies including specialized interactive displays, simulators, intelligent control systems, sensors and fused-image displays, and adaptive systems for operator and team training. Novel strategies to maintain decisive awareness by preventing impaired operating performance due to jet lag, shift work, night operations, and the loss of life and/or aircraft due to stress, inattention, or lack of vigilance are being evaluated. The primary areas of research investigated by this project are sensory systems; cognition, perception, and chronobiology; and behavioral and physiological measures of fatigue.

| (U) | B. Accomplishments/Planned Program (\$ in Millions) | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
|-----|---|----------------|----------------|----------------|
| (U) | MAJOR THRUST: Probe human sensory systems and perceptions critical for warfighter performance (auditory and | 3.363 | 3.468 | 7.856 |
| | visual processes, multi-sensory integration, and sensory biomimetics) to enhance human-machine interaction in Air | | | |
| | Force weapon systems. Research biophysical and neural mechanisms to determine human cognitive performance | | | |
| | under conditions of sleep loss, sustained operations, and non-standard sleep/wake duty cycles. | | | |
| (U) | In FY 2003: Tested theories of sensory and perceptual systems. Evaluated theories and models of perception and | | | |
| | cognition for accurate simulation and fused sensor processing. Investigated novel methods for evaluating design | | | |
| | options for visual displays used in scene analysis and command and control in several task domains. Used | | | |
| | performance metrics to critically test theories of sensory integration for image understanding. | | | |
| (U) | In FY 2004: Critically investigate and model theories of sensory and perceptual systems. Continue evaluating | | | |
| | theories and models of perception and cognition for more accurate simulation and improved fusion of sensor data. | | | |
| | Examine visual information processing techniques to improve methods for evaluating display designs, enhancing the | | | |
| | capability for collaboration, and improving the movement and sharing of information. Use performance metrics to | | | |
| | critically test theories of sensory integration to understand complex images. Probe intrinsic differences in humans | | | |
| | that make some individuals highly resistant to, and other highly susceptible to, sleep loss. | | | |
| (U) | | | | |
| | speech perception, and hearing protection. Assess multi-sensory integration methods and novel biological sensing | | | |
| | mechanisms. Probe biophysical mechanisms responsible for fatigue. Evaluate models of sleep/wake dynamics to | | | |
| | predict specific deficits in warfighter performance. | | | |
| Pro | pject 2313 R-1 Shopping List - Item No. 1-43 of 1-48 | | Exhibit R-2a | (PE 0601102F) |
| | 43 | | | |

| | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | DATE | February | 2004 |
|--|---|--|--|--|--|-----------------------------------|-----------------------------------|----------------------------|-------------------|
| BUDGET ACTIVITY 01 Basic Research | | | | PE NUMBER A 0601102F D Sciences | ND TITLE Defense Resea | rch | PROJECT NUME 2313 Human | | e |
| performance in comp theories of cognitive y (U) In FY 2003: Extended tasks to inform studied augmented by intelling and team performanced (U) In FY 2004: Extend y tasks to enable studied Continue testing mod mechanisms affecting (U) In FY 2005: Analyzed mechanisms affecting between individual sk human error in conditional states and sta | Evaluate cognition and percepti- lex, multi-interaction command- workload, alertness, and vulner d models of cognitive dimensions of automated decision-makin- ent systems. Commenced deter e under stress and sustained op- models of the cognitive dimensions of automated decision-makin- els for enhanced human perform training effectiveness of opera- models of enhanced human per- training effectiveness for oper- ill differences and interactions ions of information overload a | and control tas ability to sleep bons of human pe- g. Tested mode ermining mechan erations. tions of human p g and enhanced mance aided or ator and team pe- erformance aider ator and team p with envisioned | sks. Investigate loss. erformance in co els of enhanced h nisms affecting t performance in c risk assessment augmented by in erformance unde d or augmented erformance. Co | pehavioral and p mplex comman uman performa raining effective omplex comma and measured re telligent system stress and sust oy intelligent sy ntinue modeling | ohysiological d and control nce aided or eness for operato nd and control esponse. as. Explore ained operations stems. Assess g relationships | | 4.648 | 4.704 | 5.740 |
| and vulnerability to sl (U) In FY 2003: Improve training pedagogies. information overload (U) In FY 2004: Model r techniques. Study be and fatigue and maint (U) In FY 2005: Not App perception" efforts ea | elationships between individua havioral and physiological mea ain full spectrum air and space plicable. Note: In FY 2005, th | operator perforn een individual s and physiologic l skill difference usures to avert h vigilance. | mance. kill differences a cal measures to a es and interaction uman error in co | nd interactions vert human erro ns with envisior nditions of info | with envisioned or in conditions of ned training rmation overload | | 4.321 | 4.495 | 0.000 |
| (U) Total Cost | | | | | | | 12.332 | 12.667 | 13.596 |
| (U) <u>C. Other Program I</u> (U) Related Activities: (U) PE 0602202F, Huma | F <mark>unding Summary (\$ in Millio</mark> <u>FY 2003</u> <u>Actual</u> n | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> Estimate | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> Complete | <u>Total Cost</u> |
| Project 2313 | | F | R-1 Shopping List - | Item No. 1-44 of | 1-48 | | | Exhibit R-2a (| PE 0601102F) |

| Exhibit R-2a, RDT&E P | Project Justification | DATE February 2004 | | |
|--|--|--|--|--|
| BUDGET ACTIVITY 11 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | PROJECT NUMBER AND TITLE 2313 Human Performance | | |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Effectiveness Applied Research. U) PE 0602702F, Command, Control, and Communication. U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | |
| Project 2313 R-1 | Shopping List - Item No. 1-45 of 1-48 | Exhibit R-2a (PE 0601102 | | |

| | Ext | nibit R-2a, F | RDT&E Pro | oject Justif | fication | | | DATE | February | 2004 |
|-------------------|---|---|---|---|---|---|---|---|---|----------------------------|
| | GET ACTIVITY asic Research | | | | PE NUMBER AND 0601102F Defe Sciences | | ch | PROJECT NUME 4113 Externa Interface | BER AND TITLE II Research P | rograms |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 4113 | <u> </u> | 6.962 | 7.346 | 9.638 | | 13.769 | 15.749 | | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) | A. Mission Description and Budget Item External basic research programs interface professional interchanges and collaboration priorities, and attract talented scientists an relationships with future coalition partners institutions, and minority institutions. The interchange. | e facilitates inte ons stimulate sci d engineers to a s. Projects also | entific and eng ddress Air For seek to enhand | gineering educ rce needs. Inte ce educational | ation beneficial ernational interactions with | to the Air Forc ctions ensure for h historically b | e, increase the uture interoper lack colleges a | e awareness of A rability of coalit and universities, | Air Force basic 1 ion systems and , Hispanic servit | research l foster ng |
| (U) | B. Accomplishments/Planned Program (| <u>\$ in Millions)</u> | | | | | FY | <u>7 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| (U) (U) (U) | MAJOR THRUST: Support the Air Force In FY 2003: Provided centralized internati leveraging of, foreign science programs to of the Secretary of Defense, the Office of th coordinate international participation amon In FY 2004: Continue provide centralized and leveraging of, foreign science program Office of the Secretary of Defense, the Offic to coordinate international participation amon In FY 2005: Not Applicable. Note: In FY technology" efforts later in this Project. | onal expertise t the benefit of th ne Secretary of g appropriate U international ex s to the benefit ice of the Secret ong appropriate | assist formul e Air Force. If the Air Force, S. Departmen pertise to assist of the Air Force ary of the Air e Department of | ation of optim Provided the pr and the Air Fo at of Defense of st formulation ce. Provide the Force, and the of Defense orga | al cooperation w rimary interface orce Materiel Co organizations. of optimal coop e primary interfa e Air Force Mate anizations. | with the Office mmand to eration with, ace with the eriel Command | | 2.303 | 2.458 | 0.000 |
| (U) (U) | MAJOR THRUST: Support the internation Research and Development and the Asian (international research capabilities and make In FY 2003: Supported on-site coordination of high-level DoD delegations. Sustained a such as the Von Karman Institute. In FY 2004: Continue on-site coordination of high-level DoD delegations. Sustain and | Office of Aeros e them available n with internati and funded Air with internatio | bace Research to the Air For onal research of Force committe nal research of | and Developm rce. organizations a ment to NATO rganizations ar | nent, to identify and support inter affiliated resea ad support interr | unique mational visits rch institutes, national visits | | 2.732 | 2.803 | 0.000 |
| | ect 4113 | | | | m No. 1-46 of 1-48 | | | | Exhibit R-2a (F | PE 0601102F) |
| | | | | 46 | | | | | , | / |

| Exhibit R- | | DATE February 2004 | | | | |
|---|--|-----------------------|--|--------------|--|--|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601102F Defense Research Sciences | 4113 E | PROJECT NUMBER AND TITLE 4113 External Research Programs Interface | | | |
| as the Von Karman Institute. | | | | | | |
| (U) In FY 2005: Not Applicable. Note: In FY 2005, th technology" efforts later in this Project. | ese activities will be moved to the "international science and | | | | | |
| (U) | | | | | | |
| (U) MAJOR THRUST: Foster international science and international strategy mission. Identify and obtain u technology liaison missions of the European Office | technology cooperation by supporting the Air Force's nique foreign research capabilities through the international of Aerospace Research and Development and the Asian Office of to FY 2005, these activities were part of other efforts earlier in | 0.000 | 0.000 | 6.061 | | |
| (U) In FY 2003: Not Applicable. | | | | | | |
| (U) In FY 2004: Not Applicable. | | | | | | |
| identify unique research capabilities of high interest DoD delegations and provide primary interface to co Aid in Air Force fiscal commitments to foreign NA | se, support international technology liaison missions, and to the US Air Force. Support international visits of high-level ordinate international participation among DoD organizations. O-affiliated research institutes. | | | | | |
| (U) | | 1.027 | 2 0.95 | 2 577 | | |
| superior technical talent and forging Air Force Rese (U) In FY 2003: Supported scientist and engineer resea historically black colleges and universities, Hispania awareness of Air Force research needs throughout the and recruiting the best scientific talent to participate | serving institutions, and other minority institutions. Improved e civilian scientific community, while simultaneously identifying in critical Air Force research. | 1.927 | 2.085 | 3.577 | | |
| | serving institutions, and other minority institutions. Improve e civilian scientific community, while simultaneously identifying | | | | | |
| including historically black colleges and universities | eering research programs at U.S. colleges and universities, Hispanic serving institutions, and other minority institutions. ughout civilian scientific community, while simultaneously ticipate in critical Air Force research | | | | | |
| (U) Total Cost | | 6.962 | 7.346 | 9.638 | | |
| Project 4113 | R-1 Shopping List - Item No. 1-47 of 1-48 | | Exhibit R-2a (| PE 0601102E) | | |

| | | Exhibit D | 2a, RDT&E | | stification | | | DATE | | |
|-----|---------------------------------|--------------------------|----------------|-------------------|---|--------------------------|----------------|---|-----------------|-------------------|
| | | | za, NDIQE | FIOJECI JU | | | | | February | 2004 |
| | GET ACTIVITY Basic Research | | | | PE NUMBER AI 0601102F De Sciences | ND TITLE efense Resea | rch | PROJECT NUME 4113 Externa Interface | | Programs |
| (U) | C. Other Program Funding Sum | <u>mary (\$ in Milli</u> | <u>ons)</u> | | | | | | | |
| | | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | FY 2006 | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> | Cost to | Total Cost |
| | | <u>Actual</u> | Estimate | <u>Estimate</u> | <u>Estimate</u> | Estimate | Estimate | <u>Estimate</u> | <u>Complete</u> | <u>Total Cost</u> |
| (U) | Related Activities: | | | | | | | | | |
| (U) | PE 0601103D, University | | | | | | | | | |
| . , | Research Initiative. | | | | | | | | | |
| (U) | PE 0602102F, Materials. | | | | | | | | | |
| (U) | PE 0602201F, Aerospace Flight | | | | | | | | | |
| (0) | Dynamics. | | | | | | | | | |
| (U) | PE 0602202F, Human | | | | | | | | | |
| (0) | Effectiveness Applied Research. | | | | | | | | | |
| (U) | PE 0602203F, Aerospace | | | | | | | | | |
| (0) | Propulsion. | | | | | | | | | |
| (U) | PE 0602204F, Aerospace | | | | | | | | | |
| (0) | Avionics. | | | | | | | | | |
| (U) | PE 0602269F, Hypersonic | | | | | | | | | |
| (0) | Technology Program. | | | | | | | | | |
| | PE 0602500F, | | | | | | | | | |
| (U) | Multi-Disciplinary Space | | | | | | | | | |
| | Technology. | | | | | | | | | |
| (U) | PE 0602601F, Space | | | | | | | | | |
| (0) | Technology. | | | | | | | | | |
| (U) | PE 0602602F, Conventional | | | | | | | | | |
| (0) | Munitions. | | | | | | | | | |
| (U) | PE 0602702F, Command, | | | | | | | | | |
| (0) | Control and Communication. | | | | | | | | | |
| (U) | D. Acquisition Strategy | | | | | | | | | |
| | Not Applicable. | | | | | | | | | |
| | | | | | | | | | | |
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| 1 | | | | | | | | | | |
| | | | | | | | | | | |
| | | | - | | | 40 | | | | |
| Pro | ject 4113 | | F | K-1 Shopping List | - Item No. 1-48 of 1 | -48 | | | Exhibit R-2a (| PE 0601102F) |

PE NUMBER: 0601103F PE TITLE: University Research Initiatives

| Exhi | bit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 |
|---|---|-------------------------------------|-------------------------------------|------------------------------|-------------------------------------|---------------------------------|----------------------------------|-----------------|-------------------|
| BUDGET ACTIVITY 01 Basic Research | | | | E NUMBER AND 601103F Univ | TITLE versity Resea | rch Initiative | s | <u> </u> | |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| Total Program Element (PE) Cost | 0.000 | 106.313 | 115.865 | 110.092 | 110.273 | 110.924 | 113.020 | | 0.00 |
| 5094 University Research Initiatives Note: In FY 2004, the Office of the Secretary of | 0.000 | 106.313 | 115.865 | 110.092 | 110.273 | 110.924 | 113.020 | | 0.00 |
| (U) <u>A. Mission Description and Budget Ite</u> This program supports defense-related be enhances and promotes the education of assists universities in establishing super- | asic research in a U.S. scientists ar or instrumentatio | nd engineers in n capabilities r | disciplines crit needed to impro | tical to maintain | ning, advancing of defense-relat | , and enabling ted research and | future U.S. de d education. A | fense technolog | ies; and omponent |
| of this program is the recognition that fuU) <u>B. Program Change Summary (\$ in M</u> | Ç | and technolog | y exploitations | require nignly | | a concerted mu | | 2004 | TS. FY 2005 |
| U) Previous President's Budget | | | | | | 0.000 | | 5.224 | 116.169 |
| U) Current PBR/President's Budget | | | | | | 0.000 | 106 | 5.313 | 115.865 |
| U) Total Adjustments | | | | | | 0.000 | 1 | 1.089 | |
| J) Congressional Program Reductions | | | | | | | | | |
| Congressional Rescissions | | | | | | | -0 |).911 | |
| Congressional Increases | | | | | | | 2 | 2.000 | |
| Reprogrammings | | | | | | | | | |
| SBIR/STTR Transfer | | | | | | | | | |
| U) Significant Program Changes: | | | | | | | | | |
| Not Applicable. | | | | | | | | | |
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| | | | | | | | | | |
| | | R-1 S | Shopping List - Ite | em No. 2-1 of 2-4 | | | | Exhibit R-2 (I | PE 0601103F |

| | ExI | hibit R-2a, I | RDT&E Pro | oject Justif | fication | | | DATE | February | 2004 |
|---|--|--|---|--|---|---|---------------------------------|-------------------------------------|-----------------------------------|--------------------------|
| | ET ACTIVITY asic Research | | | | PE NUMBER AND 0601103F Uni Initiatives | | arch | | BER AND TITLE sity Research | Initiatives |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 5094 | University Research Initiatives | 0.000 | 106.313 | 115.865 | 110.092 | 110.273 | 110.924 | 113.020 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles In FY 2004, the Office of the Secretary of | 0 | 0 | 0 | 0 | 0 | 0 | ů. | | |
| | A. Mission Description and Budget Iter This program supports defense-related ba enhances and promotes the education of U assists universities in establishing superio of this program is the recognition that fut | sic research in a J.S. scientists a or instrumentation | a wide range of nd engineers in on capabilities | n disciplines cri needed to impr | itical to maintai rove the quality | ning, advancing of defense-rela | g, and enabling ated research a | g future U.S. de nd education. A | fense technolog fundamental co | gies; and component |
| (U) I | B. Accomplishments/Planned Program (MAJOR THRUST: Promote fundamental, In FY 2003: Not Applicable. | | i-disciplinary s | cience and eng | gineering resear | ch projects. | <u>F</u> | <u>Y 2003</u> 0.000 | <u>FY 2004</u> 52.548 | <u>FY 2005</u> 62.198 |
| t i f (U) I t r i e f | In FY 2004: Issue competitive research aw usually not achievable through single investor o transformational and high priority techn information fusion, smart materials and str propulsion and control, enhancing human p instrumentation development. Continue fur in FY 2005: Fund competitive research aw echnologies usually not achievable throug research areas related to transformational conformatics, biotechnologies (e.g., biomim energy and power conversion, high energy funding of multi-disciplinary programs beau | stigator awards. ologies, such as uctures, efficien performance, ar unding of multi- vards at U.S. un th typical single capabilities and etic sensory net propellants and | Topics will be s nanotechnolog nt energy and p nd improving re disciplinary pr iversities to foc investigator av high priority te works, intellig d materials, and | e selected in so gy, biomimetic oower conversi- esearch related ograms begun cus on underpin wards. Topics echnologies, su ent information | cientific research e sensor network on, high energy to student train in prior years. nning Air Force will be selected uch as nanotechin n fusion, smart f | h areas related cs, intelligence materials for ing in -related l in scientific hology, materials, etc.), | | | | |
| (U) I (U) I | MAJOR THRUST: Support post-graduate, disciplines at U.S. universities. In FY 2003: Not Applicable In FY 2004: Award approximately 170 hig Defense Science and Engineering Graduate | shly competitive | e graduate fello | owships as part | of the FY 2004 | National | | 0.000 | 34.520 | 39.670 |
| Proje | ect 5094 | | R-1 \$ | Shopping List - It | tem No. 2-2 of 2-4 | | | | Exhibit R-2a (I | PE 0601103F) |
| | | | | 50 |) | | | | | |

| Exhibit R-2a, RDT&E Project | Justification | DA | TE February | / 2004 |
|--|---|-------|-----------------------------------|---------------|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601103F University Research Initiatives | | JMBER AND TITLE ersity Researc | |
| tri-Service and Office of the Director of Defense Research and Engineering comfor graduate and undergraduate research experiences including those established. Support Undergraduate Research Education program. Promote and advance rearesearch under Federal programs such as the Presidential Early Career Award for funding for awards made under prior year Department of Defense programs. (U) In FY 2005: Award approximately 180 highly competitive graduate fellowships Defense Science and Engineering Graduate Fellowship Program. Fellowships a and Office of the Director of Defense Research and Engineering competition. S graduate and undergraduate research experiences including those established un Support Undergraduate Research Education program. Stimulate and recognize Federal programs such as the Presidential Early Career Award for Scientists and awards made under prior year Department of Defense programs. | I under the Awards to Stimulate and cognition of superior academic or Scientists and Engineers. Continue as part of the FY 2005 National are awarded under a joint tri-Service Support competitive awards for der the Awards to Stimulate and superior academic research under | | | |
| (U) (U) MAJOR THRUST: Enhance the scientific and engineering research and educati | on infrastructure and instrumentation | 0.000 | 17.261 | 13.997 |
| at U.S. universities. (U) In FY 2003: Not Applicable. (U) In FY 2004: Conduct the competition for U.S. universities to establish unique c instrumentation and infrastructure under the Defense University Research Instru (U) In FY 2005: Conduct the competition for U.S. universities to acquire state-of-th instrumentation and infrastructure to enhance research and educational capabilit Research Instrumentation Program. | imentation Program. ne-art, high technology | | | |
| (U) (U) CONGRESSIONAL ADD: Network and Information Space Security Center. (U) In FY 2003: Not Applicable. (U) In FY 2004: Conduct fundamental multidisciplinary scientific research associat efforts. (U) In FY 2005: Not Applicable. | ed with network and information | 0.000 | 0.992 | 0.000 |
| (U) (U) CONGRESSIONAL ADD: Kelly Material Science and Engineering Laboratory (U) In FY 2003: Not Applicable. (U) In FY 2004: Conduct fundamental multidisciplinary scientific research at Kelly Laboratory. | | 0.000 | 0.992 | 0.000 |
| (U) In FY 2005: Not Applicable.(U) Total Cost | | 0.000 | 106.313 | 115.865 |
| | g List - Item No. 2-3 of 2-4 | | | (PE 0601103F) |

| Exhibit R-2a, RDT | &E Project Justification | DATE February 2004 |
|---|--|---|
| BUDGET ACTIVITY D1 Basic Research | PE NUMBER AND TITLE 0601103F University Research Initiatives | PROJECT NUMBER AND TITLE 5094 University Research Initiative |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | |
| U) D. Acquisition Strategy Not Applicable. | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Project 5094 | R-1 Shopping List - Item No. 2-4 of 2-4 | Exhibit R-2a (PE 0601103 |

PE NUMBER: 0601108F PE TITLE: High Energy Laser Research Initiatives

| | Exhib | oit R-2, RDT | 「&E Budge | t Item Just | ification | | | DATE | February | 2004 |
|------|--|--|--|---|--|---|--|---|--|---------------------------------------|
| | ET ACTIVITY I sic Research | PE NUMBER AND TITLE 0601108F High Energy Laser Research Initiatives | | | | | | | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| | Total Program Element (PE) Cost | 0.000 | 11.961 | 12.331 | 12.467 | 12.716 | 12.872 | 13.096 | 0.000 | 0.000 |
| 5097 | High Energy Laser Research Initiatves In FY 2004, this program was transferred | | 11.961 | 12.331 | 12.467 | 12.716 | 12.872 | 13.096 | 0.000 | 0.000 |
| | A. Mission Description and Budget Item This program funds basic research aimed a advantages, including speed-of-light veloc potential to perform a wide variety of mili anti-aircraft missiles; and ultra-precision n science and technology conducted by the l systems and Service missions while comp addressed in key areas such as chemical la and experimental investigations. This program is in Budget Activity 1, Bas | at developing fi city, high precisi tary missions in negation of targ HEL JTO. In g lementing Serv asers, solid state ic Research, be | tion, significant neluding interce ets in urban en eneral, efforts ice/Agency pro- e lasers, beam c cause it funds s | t magazine depi eption of ballist vironments with funded under th ograms that are control, optics, p scientific study | th, low-cost per tic missiles in b h no collateral on his program are directed at more propagation, an and experimen | r kill, and reduct poost phase; def damage. This p chosen for their re specific Serve d free electron tation. Through | ed logistics rec eat of high-spe program is part r potential to h ice needs. A be lasers. The pro | uirements. As ed, maneuverin of an overall D ave a broad im road range of to ogram funds th the Air Force | a result, HELs ag anti-ship and OOD effort in H pact on multipl echnologies are eoretical, comp | have the EL e HEL utational, |
| | directed toward increasing knowledge and B. Program Change Summary (\$ in Mil | | in those fields | of science and | engineering rel | - | | - | 2004 | EV 2005 |
| (U) | Previous President's Budget | | | | | i | <u>FY 2003</u> 0.000 | <u>FY 2</u> | .063 | <u>FY 2005</u> 12.363 |
| | Current PBR/President's Budget | | | | | | 0.000 | | .003 | 12.303 |
| . , | Total Adjustments | | | | | | 0.000 | | .102 | 12.551 |
| (U) | Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings SBIR/STTR Transfer Significant Program Changes: | | | | | | | | .102 | |
| · / | In FY 2004, this program was transferred | | | | | | | | | |

| BUDGET ACTIVITY PF UNDRE AND TILE PROJECT AVMERE AND TILE 061 Basic Research Cost (\$ in Millions) PY 2003 PY 2004 PY 2005 PY 2007 PY 2008 PY 2009 Cost to Total 5097 High Energy Laser Research Initiatives 0.000 11.061 12.331 12.467 12.716 12.872 13.096 0.000 0. | | Exh | nibit R-2a, I | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|--|-------------------|---|--|--|---|---|---|--|--|--|---|
| Cost S in Millions)ActualEstimateEstimateEstimateEstimateEstimateEstimateEstimateEstimateComplete3097High Energy Laser Research Initiates0.00011.96112.3112.46112.71612.87213.0960.0000.000Quantity of RDT&E Aricles00< | | | | | C | 601108F Hig | h Energy Las | | 5097 High Energy Laser Research | | |
| Actual Estimate < | | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| Quantity of RDT&E Articles 0 </td <td></td> <td></td> <td></td> <td>Estimate</td> <td></td> <td></td> <td></td> <td>Estimate</td> <td></td> <td></td> <td></td> | | | | Estimate | | | | Estimate | | | |
| (II) A.Mission Description and Budget Item Justification This program funds basic research aimed at developing fundamental scientific knowledge to support future DOD HEL systems. HEL systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase: defeat of high-speed, maneuvering anti-ship and anti-arrital missiles; and ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall DOD effort in HEL systems and Service missions while complementing Service/Agency programs that mate directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics, propagation, and free electron lasers. The program funds theoretical, computational, and experimental investigations. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation. Through this program, the Air Force invests in research directed toward increasing knowledge and understanding in those fields of science and engineering related to long-term national security needs. (I) For FY 2003, this activity was performed under PE 0601108D8Z, High Energy Laser Initiative, and the funding for FY 2003 was approximately \$12.1 million. (I) MAJOR THRUST: Conduct fundamental research in solid state lasers focused on breaching the cost, power, and 0.000 2.320 2.420 ergention and the ability to operate at high temperatures, athermal laser gain media, modular and scalable architectures for laser power scaling, means of increasing efficiency in excess of 20%, operation in harsh environments, and corrections for thermally induced distorions in gain media. Research f | 509 | | 0.000 | 11.961 | 12.331 | 12.467 | 12.716 | 12.872 | 13.096 | 0.000 | 0.000 |
| This program funds basic research aimed at developing fundamental scientific knowledge to support future DOD HEL systems. HEL systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine deph, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall DOD effort in HEL systems and Service insisons while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics, propagation, and free electron lasers. The program funds theoretical, computational, and experimental investigations. This program is in Budget Activity 1. Basic Research, because it funds scientific study and experimentation. Through this program, the Air Force invests in research directed to ward increasing knowledge and understanding in those fields of science and engineering related to long-term national security needs. (U) B. Accomplishments/Planned Program (S in Millions) FY 2003 FY 2004 FY 2005 (U) B. Accomplishments/Planned Program (S in Millions) FY 2003 FY 2004 FY 2005 (U) In FY 2003. Not Applicable. In Second Program (S in Millions) FY 2004 FY 2005 (U) In FY 2003: Not Applicable. In Fy | | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) B. Accomplishments/Planed Program (\$ in Millions) (U) For FY 2003, this activity was performed under PE 0601108D8Z, High Energy Laser Initiative, and the funding for FY 2003 was approximately \$12.1 million. (U) MAJOR THRUST: Conduct fundamental research in solid state lasers focused on breaching the cost, power, and efficiency barriers to achieving the promise of simplified logistics and platform integration. (U) In FY 2003: Not Applicable. (U) In FY 2004: Conduct research in areas of interest including laser materials with large fluorescence lifetime and cross-section and the ability to operate at high temperatures, athermal laser gain media. Research focuses on ceramic gain material fabrication methods, low absorption laser gain media, laser-diode pump sources, fiber lasers, and vertical external cavity laser brightness and power estraction through advancements in cooling and fabrication techniques. Pursuant to the nature of the university-led multidisciplinary research initiative program, all of the efforts to address the above research in areas of interest including laser materials with large fluorescence lifetime and cross-section and the ability to operate at high temperatures, athermal laser gain media, all of the efforts to address the above research areas begun during FY 2002 continue to receive funding. (U) In FY 2005: Conduct research in areas of interest including laser materials with large fluorescence lifetime and cross-section and the ability to operate at high temperatures, athermal laser gain media, modular and scalable | (U) | This program funds basic research aimed a advantages, including speed-of-light veloc potential to perform a wide variety of mili anti-aircraft missiles; and ultra-precision m science and technology conducted by the h systems and Service missions while comp addressed in key areas such as chemical la and experimental investigations. This program is in Budget Activity 1, Bas | at developing f city, high precisi- tary missions in negation of targ HEL JTO. In g lementing Serv asers, solid state ic Research, be | tion, significan ncluding interce ets in urban en eneral, efforts ice/Agency pro- e lasers, beam co cause it funds s | t magazine dep eption of ballis vironments wit funded under t ograms that are control, optics, scientific study | oth, low-cost per stic missiles in t th no collateral his program are directed at mor propagation, ar | r kill, and reduce boost phase; def damage. This j chosen for the re specific Serv ad free electron station. Throug | ted logistics re feat of high-sporogram is part ir potential to lice needs. A to lasers. The pr h this program | equirements. A eed, maneuver t of an overall have a broad ir broad range of rogram funds th h, the Air Force | s a result, HELs ing anti-ship and DOD effort in H npact on multipl technologies are neoretical, comp | have the l EL e HEL v utational, |
| (U) MAJOR THRUST: Conduct fundamental research in solid state lasers focused on breaching the cost, power, and efficiency barriers to achieving the promise of simplified logistics and platform integration. (U) In FY 2003: Not Applicable. (U) In FY 2004: Conduct research in areas of interest including laser materials with large fluorescence lifetime and cross-section and the ability to operate at high temperatures, athermal laser gain media, modular and scalable architectures for laser power scaling, means of increasing efficiency in excess of 20%, operation in harsh environments, and corrections for thermally induced distortions in gain media. Research focuses on ceramic gain material fabrication methods, low absorption laser gain media, laser-diode pump sources, fiber lasers, and vertical external cavity laser brightness and power extraction through advancements in cooling and fabrication techniques. Pursuant to the nature of the university-led multidisciplinary research initiative program, all of the efforts to address the above research in areas of interest including laser materials with large fluorescence lifetime and cross-section and the ability to operate at high temperatures, athermal laser gain media, modular and scalable (U) In FY 2005: Conduct research in areas of interest including laser materials with large fluorescence lifetime and cross-section and the ability to operate at high temperatures, athermal laser gain media, modular and scalable | (U) | B. Accomplishments/Planned Program (S) For FY 2003, this activity was performed u | \$ in Millions) nder PE 06011 | | | | - | | - | <u>FY 2004</u> | <u>FY 2005</u> |
| Project 5097 R-1 Shopping List - Item No. 3-2 of 3-6 Exhibit R-2a (PE 0601108F) | (U) (U) (U) | efficiency barriers to achieving the promise In FY 2003: Not Applicable. In FY 2004: Conduct research in areas of it cross-section and the ability to operate at hit architectures for laser power scaling, means environments, and corrections for thermally material fabrication methods, low absorption external cavity laser brightness and power of Pursuant to the nature of the university-led the above research areas begun during FY 2 In FY 2005: Conduct research in areas of | e of simplified l nterest includir igh temperature s of increasing y induced disto on laser gain mo extraction throu multidisciplina 2002 continue t interest includi | ogistics and pla ng laser materia es, athermal las efficiency in ex- rtions in gain n edia, laser-diod ugh advanceme ry research init o receive fundi ng laser materi | atform integrat als with large fl er gain media, xcess of 20%, o nedia. Researc le pump source ents in cooling a tiative program ing. als with large f | ion. luorescence life modular and sc operation in har h focuses on ce es, fiber lasers, a and fabrication h, all of the effo | time and alable sh ramic gain and vertical techniques. rts to address etime and | | 0.000 | 2.320 | 2.420 |
| | Pro | ject 5097 | | R-1 \$ | Shopping List - It | em No. 3-2 of 3-6 | | | | Exhibit R-2a (F | PE 0601108F) |

| Exhibit R-2a, RDT&E F | DAT | DATE February 2004 | | |
|---|---|-----------------------|----------------------------------|-------|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601108F High Energy Laser Research Initiatives | | MBER AND TITLE Energy Laser R | |
| architectures for laser power scaling, means of increasing efficiency i environments, and corrections for thermally induced distortions in ga university-led multidisciplinary research initiative program, all of the begun during FY 2002 will continue to receive funding. | in media. Pursuant to the nature of the | | | |
| (U)(U) MAJOR THRUST: Conduct fundamental research in high-power, light | abtwoight option | 0.000 | 1.910 | 1.960 |
| (U) In FY 2003: Not Applicable. | gitweight opties. | 0.000 | 1.910 | 1.900 |
| (U) In FY 2004: Conduct research in areas of interest including basic malightweight structure and deployment concepts, HEL optical coatings correction combined with aperture adjustment), and control mechanis coating materials to match zero expansion substrates and measure the Begin investigation of heat transfer in micromachined adaptive mirro align, and coat large off-axis aspherical optics. Pursuant to the nature initiative program, all of the efforts to address the above research area funding. | , multipurpose materials (e.g., wavefront ms. Develop negative thermal expansion optical rmal and strain responses of these coatings. rs. Develop methods to fabricate, measure, e of the university-led multidisciplinary research as begun during FY 2002 will continue to receive | | | |
| (U) In FY 2005: Conduct research in areas of interest including basic ma lightweight structure and deployment concepts, HEL optical coatings correction combined with aperture adjustment), and control mechanis multidisciplinary research initiative program, all of the efforts to addu 2002 will continue to receive funding. | , multipurpose materials (e.g., wavefront sms. Pursuant to the nature of the university-led | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Conduct research focused on the scientific concerning atmospheric characterization in aerial, battlefield, and marin to substantial increases in the lethality of HEL systems without the net of the systems without the net of the systems. | time-like environments. These efforts could lead | 0.000 | 3.313 | 3.351 |
| (U) In FY 2003: Not Applicable. | d the creation l and commuter based analysis of | | | |
| (U) In FY 2004: Conduct research in areas of interest including improve propagation effects, advanced wavefront sensing and reconstruction (and the effects of extended reference sources used for wavefront corr- wavefront control, imaging and tracking through turbulence, and mod Pursuant to the nature of the university-led multidisciplinary research the above research areas that were begun during FY 2002 continue to | especially in the presence of thermal blooming), ection. Research focuses on new methods for leling and simulation of beam propagation. initiative program, all of the efforts to address | | | |
| (U) In FY 2005: Conduct research in areas of interest including improve | | | | |
| propagation effects, advanced wavefront sensing and reconstruction (and the effects of extended reference sources used for wavefront corr | | | | |
| Project 5097 | R-1 Shopping List - Item No. 3-3 of 3-6 | | Exhibit R-2a (F | |

| Exhibit R-2a, RDT&E Pro | DA | DATE February 2004 | | |
|---|---|--|-----------------|--------------|
| BUDGET ACTIVITY 01 Basic Research | PE NUMBER AND TITLE 0601108F High Energy Laser Research Initiatives | PROJECT NUMBER AND TITLE 5097 High Energy Laser Resea Initiatves | | |
| university-led multidisciplinary research initiative program, all of the eff were begun during FY 2002 will continue to receive funding. | forts to address the above research areas that | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Conduct fundamental research in chemical lasers to | o improve the understanding of the processes | 0.000 | 1.208 | 1.200 |
| necessary for the realization of truly closed cycle, lightweight, high-pow | | | | |
| (U) In FY 2003: Not Applicable. | | | | |
| (U) In FY 2004: Conduct research in areas of interest including studies of a | chemical processes and reactions for a | | | |
| closed-cycle chemical laser system, new sources of the high-energy chemical | mical species needed to produce the lasing | | | |
| event, and electrically driven oxygen iodine laser architectures. Measur | e chemical kinetics for an all gas phase | | | |
| chemical laser and study plasma physics of an electrically driven oxyger | | | | |
| of the university-led multidisciplinary research initiative program, all of | f the efforts to address the above research areas | | | |
| that were begun during FY 2002 continue to receive funding. | | | | |
| (U) In FY 2005: Conduct research in areas of interest including studies of c | | | | |
| closed-cycle chemical laser system, new sources of the high-energy chemical laser system. | | | | |
| event, and novel recovery systems for regeneration of the laser fuels. Pu | - | | | |
| multidisciplinary research initiative program, all of the efforts to address | s the above research areas that were begun | | | |
| during FY 2002 will continue to receive funding. | | | | |
| (U)(U) MAJOR THRUST: Conduct fundamental research in high-average-pow | war ultre short pulse free electron lesers to | 0.000 | 1.710 | 1.900 |
| significantly increase the average power obtainable by ultra-short-pulse | * | 0.000 | 1.710 | 1.900 |
| significantly increase the average power obtainable by una-short-pulse size and cost. | free electron fasers, while decreasing relative | | | |
| (U) In FY 2003: Not Applicable. | | | | |
| (U) In FY 2004: Conduct research in areas of interest including high-curren | nt devices and control methods, higher | | | |
| damage threshold resonator optics, advanced optical cavity designs for h | | | | |
| methods for scaling free electron lasers to reach multi-megawatt class av | • • • • | | | |
| dispenser photocathodes, free electron laser beam dynamics, methods to | • | | | |
| methods to improve free electron laser energy recovery process. Pursua | ant to the nature of the university-led | | | |
| multidisciplinary research initiative program, all of the efforts to address | s the above research areas that were begun | | | |
| during FY 2002 continue to receive funding. | | | | |
| (U) In FY 2005: Conduct research in areas of interest including high-current | | | | |
| damage threshold resonator optics, advanced optical cavity designs for h | • • • • | | | |
| methods for scaling free electron lasers to reach multi-megawatt class av | • | | | |
| the university-led multidisciplinary research initiative program, all of the | e efforts to address the above research areas | | | |
| that were begun during FY 2002 will continue to receive funding. | | | | |
| Project 5097 R-1 | Shopping List - Item No. 3-4 of 3-6 56 | | Exhibit R-2a (I | PE 0601108F) |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|---------------------------------|---|---|---|----------------------------|--|----------------------------|----------------------------|--|-----------------------------------|--------------|
| | GET ACTIVITY Basic Research | | | | PE NUMBER A 0601108F H Research Ir | ligh Energy La | aser | PROJECT NUMI 5097 High Er Initiatves | esearch | |
| (U) | MAJOR THRUST: Conduct fundar In FY 2003: Not Applicable. In FY 2004: Continue development technical analyses, engineering trade systems' military utility in a broad ra | of models and s e studies that allo | imulation techn ow analyses of a | iques to achieve | e a balance betwe | | | 0.000 | 1.500 | 1.500 |
| | In FY 2005: Continue development technical analyses, engineering trade systems' military utility in a broad ra Total Cost | of models and si e studies that allo | mulation techni | - | | | | 0.000 | 11.961 | 12.331 |
| (U) | C. Other Program Funding Summ | nary (\$ in Millio <u>FY 2003</u> <u>Actual</u> | ons) <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> Estimate | <u>FY 2006</u> Estimate | <u>FY 2007</u> Estimate | <u>FY 2008</u> Estimate | <u>FY 2009</u> Estimate | <u>Cost to</u> <u>Complete</u> | Total Cost |
| (U) (U) (U) (U) (U) | PE 0602500F, Multi-Disciplinary Space Technology. PE 0602890F, High Energy Laser Research. PE 0603444F, Maui Space Surveillance System. PE 0603500F, Multi-Disciplinary Advanced Development Space Technology. PE 0603605F, Advanced Weapons Technology. PE 0603924F, High Energy Laser Advanced Technology Program. | | | | | | | | | |
| (U) (U) | PE 0603883C, Ballistic Missile Defense Boost Phase Segment. PE 0602605F, Directed Energy Technology. | | | | | | | | | |
| Pro | ject 5097 | | | R-1 Shopping Lis | t - Item No. 3-5 of | 3-6 | | | Exhibit R-2a (F | PE 0601108F) |

| Exhibit R-2a, RDT&E P | Project Justification | | DATE February 2004 |
|--|---|--|--------------------------|
| BUDGET ACTIVITY 11 Basic Research | | | |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> PE 0602307A, Advanced Weapons Technology. PE 0602114N, Power Projection Applied Research. This project has been coordinated through the U) Reliance process to harmonize efforts and eliminate duplication. | | | |
| U) D. Acquisition Strategy Not Applicable. | | | |
| Project 5097 R | -1 Shopping List - Item No. 3-6 of 3-6 58 | | Exhibit R-2a (PE 0601108 |

PE NUMBER: 0602102F PE TITLE: Materials

| | Exhibit R-2, RDT&E Budget Item Justification | | | | | | | | ATE February 2004 | |
|------|---|---------|----------|--------------|----------|----------|----------|----------|----------------------|-------|
| | | | | E NUMBER AND | | | | - | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| | Total Program Element (PE) Cost | 105.237 | 109.222 | 73.660 | 71.548 | 77.516 | 80.112 | 77.598 | 0.000 | 0.000 |
| 4347 | Materials for Structures, Propulsion, and Subsystems | 65.429 | 64.131 | 41.057 | 40.876 | 45.924 | 47.644 | 44.371 | 0.000 | 0.000 |
| 4348 | Materials for Electronics, Optics, and Survivability | 18.253 | 19.252 | 12.437 | 11.716 | 12.080 | 12.444 | 12.728 | 0.000 | 0.000 |
| 4349 | Materials Technology for Sustainment | 16.933 | 16.204 | 17.825 | 16.562 | 17.054 | 17.503 | 17.916 | 0.000 | 0.000 |
| 4915 | Deployed Air Base Technology | 3.367 | 9.635 | 2.341 | 2.394 | 2.458 | 2.521 | 2.583 | 0.000 | 0.000 |
| 5015 | Rocket Materials Technology | 1.255 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Note: In FY 2003, space unique tasks in Projects 4347 and 4348 were transferred to PE 0602500F, Project 5025, Space Materials Development, as a result of the Space Commission recommendation to consolidate all space unique activities. In FY 2004, space unique tasks in Project 5015 will be transferred to PE 0602500F, Project 5025, as a result of the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description and Budget Item Justification

This program develops advanced materials, processing, and inspection technologies to reduce life cycle costs and improve performance, affordability, supportability, reliability, and survivability of current and future Air Force systems and operations. The program has four projects that develop: (1) structural, propulsion, and sub-systems materials and processes technologies; (2) electronic, optical, and survivability materials and processes technologies; (3) sustainment materials, processes technologies, and advanced non-destructive inspection methodologies; and (4) air base operations technologies including deployable base infrastructure, force protection, and and fire fighting capabilities. Note: In FY 2004, Congress added \$1.5 million for Composite Fire Safety Consortium, \$2.6 million for Advanced Wide Bandgap Materials, \$1.0 million for Computational Tools for Material Development, \$1.7 million for Gallium Nitride Microelectronics and Material Development, \$2.4 million for Tyndall Air Force Research Laboratory Research and Development, \$1.0 million for Discontinuous Titanium Matrix Composites Frogram, \$1.4 million for Closed Cell Foam Material, \$2.8 million for Ultraviolet Free Electron Laser (UV FEL) Capabilities for Aerospace Microfabrication, \$10.0 million for Strategic Partnership for Research in Nanotechnology (SPRING), \$1.2 million for Microfabrication, and \$1.5 million for Composite Materials for Unmanned Air Vehicles (UAV) Initiative. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

R-1 Shopping List - Item No. 4-1 of 4-20

| | UNCLASSIFIED | | | | | | | | |
|-----|---|---|----------------|----------------|--|--|--|--|--|
| | Exhibit R-2, RDT&E Bu | udget Item Justification | DATE Feb | ruary 2004 | | | | | |
| | GET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602102F Materials | | | | | | | |
| (U) | B. Program Change Summary (\$ in Millions) | | | | | | | | |
| | | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | | | | | |
| (U) | Previous President's Budget | 106.955 | 68.657 | 68.283 | | | | | |
| (U) | Current PBR/President's Budget | 105.237 | 109.222 | 73.660 | | | | | |
| (U) | Total Adjustments | -1.718 | 40.565 | | | | | | |
| (U) | Congressional Program Reductions | | | | | | | | |
| | Congressional Rescissions | | -0.935 | | | | | | |
| | Congressional Increases | | 41.500 | | | | | | |
| | Reprogrammings | | | | | | | | |
| | SBIR/STTR Transfer | -1.718 | | | | | | | |
| (U) | Significant Program Changes: | | | | | | | | |
| | Not Applicable. | | | | | | | | |

R-1 Shopping List - Item No. 4-2 of 4-20

| | ExI | hibit R-2a, I | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|---|---|---|---|--|--|--|--|--|--|---|
| | et activity plied Research | | | | PE NUMBER AND | | | | BER AND TITLE Is for Structu and Subsyste | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| 4347 | Materials for Structures, Propulsion, and Subsystems | 65.429 | 64.131 | 41.057 | 40.876 | 45.924 | 47.644 | | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| space | In FY 2003, space unique tasks in Project unique activities. A. Mission Description and Budget Iter This project develops the materials and pr Air Force systems. A family of affordabl composites to provide upgraded capabiliti turbine engine materials that will enable end developed that are affordable, lightweight Alternative or replacement materials are the and other pervasive nonstructural materials advanced processing methods to enable and | n Justification rocessing techno e lightweight m ies for existing a engine designs t t, dimensionally being developed ls technologies | blogy base for aterials is bein aircraft, missile o double the tu stable, therma l to maintain th are being deve | aircraft and mis g developed, in e, and propulsion where engine the ally conductive, he performance cloped for propu | ssiles to improv neluding metals on systems to m rust to weight r , and/or ablation of aging operat | re affordability, , polymers, cera neet the future s ratio. Advance n and erosion re- tional systems. | maintainabilit amics, metallic ystem requirer d high tempera esistant to mee Friction and v | y, and performa composites, ar nents. Develop ature protection t aerospace and wear-resistant m | ance of current and nonmetallic shigh-temperat materials are be missile requires aterials, paints, | and future ture eing ments. coatings, |
| | . Accomplishments/Planned Program (| | 0 1 | | | | FY | <u> 2003</u> | FY 2004 | FY 2005 |
| | 1AJOR THRUST: Develop ceramics and | | composite tecl | hnologies for re | evolutionary pe | rformance and | <u></u> | 3.208 | 4.721 | 4.733 |
| (U) In set set set set set set set set set set | upportability improvements in advanced p n FY 2003: Tested advanced ceramic com- ervice life conditions, using the data for d urable thermal protection materials for ae ther specialized testing. Developed labor tanium alloy substrates. Evaluated more netrface coatings. n FY 2004: Design new advanced ceramic or aircraft applications. Develop advance ontaining stress concentration sites. Deve eramic composite structures for advanced | posites for exhaurability assession rospace vehicle atory-scale rada durable ceramic cs and ceramic of d analytical techelop advanced a combustor app | aust and hot se ment and life p s with aircraft- ar absorbing ma c composites be composites with aniques to pred nalytical mode lications. Desi | ction componen- prediction devel- like operability aterial coating r ased on emergi h improved dur lict the life of a els to design int | hts under real and opment. Devel through hot ac repair for super- ng fibers and ac rability and frac dvanced ceram egrally woven, | nd simulated loped highly coustic and alloy and/or dvanced cture resistance ic composites actively cooled | | | | |
| (U) I | nvironments using the best available fiber n FY 2005: Develop damage resistant adv nvironments. Test tip rub tolerant concep | anced ceramic | composites for | - | - | | | | | |
| Proje | ct 4347 | | R-1 S | Shopping List - Ite | m No. 4-3 of 4-20 |) | | | Exhibit R-2a (F | PE 0602102F) |

| Exhibit R-2a, RDT&E Project | DA | February | 2004 | | |
|---|--|-----------|---|-------|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602102F Materials | 4347 Mate | ECT NUMBER AND TITLE Materials for Structures, ulsion, and Subsystems | | |
| prediction model to permit prediction of its durability under stress gradients, tem thermal exposure. Fabricate and test integrally cooled ceramic composite sub-el Develop laboratory-scale advanced fiber-matrix interface concepts, optimizing of state-of-the-art ceramic composites in severe environments. | lements and small components. | | | | |
| (U) | | | | | |
| (U) MAJOR THRUST: Develop materials processing technologies involving proces and advanced non-invasive sensors. | s models, advanced control methods, | 2.000 | 2.470 | 2.731 | |
| (U) In FY 2003: Investigated the feasibility of using evanescent microwave or inelas surface and near-surface region as a process sensor. Evaluated new techniques f phase behavior simulations for nanomaterial process design. Transitioned an int environment, which allows rapid design interaction between multiple sites over tunable laser processing tool for micro-engineered aerospace components and su | for generating large-scale dynamic and teractive design-manufacturing the Internet. Tested a high-power, | | | | |
| (U) In FY 2004: Evaluate the use of evanescent microwave sensors for evaluating la Establish baseline parameters for selected techniques for generating large-scale of simulations for nanomaterial process design. Investigate process control of optic control of optical and multi-functional coatings for transfer to industry. Initiate a produce variation in composites. Investigate nucleation and growth mechanism order to optimize manufacturing ability. | ser damage and subsurface corrosion. dynamic and phase behavior cal deposition for scale-up and stress studies of processing relationships to | | | | |
| (U) In FY 2005: Evaluate Raman imaging as an in situ process sensor for processing Initiate validation process for large-scale dynamic and phase behavior simulation Continue investigation and evaluation of process control of optical deposition fo optical and multi-functional coatings. Continue investigation of variability in co commercial transition. Continue exploration of carbon nanotube growth for con | ns for nanoparticle processing. or scale-up and stress control of omposites for enhanced control and | | | | |
| (U) | innererar scaraority. | | | | |
| (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop enabling polymeric ma applications including enhanced aircraft canopies, micromechanical devices, adv low-observable platforms. Note: In FY 2003, this effort includes Congressional Partnership for Nanotechnology Research and \$1.0 million for Closed Cell Foan includes Congressional Adds of \$4.2 million for Microfabrication, \$1.0 million for \$10.0 million for Strategic Partnership for Research in Nanotechnology (SPRIN) | vanced wiring concepts, and improved Adds of \$6.0 million for Strategic n Material. In FY 2004, this effort for Nanotechnology Research, and | 9.407 | 18.025 | 3.276 | |
| (U) In FY 2003: Confirmed feasibility of nanostructured materials for temperature-reapplicability for gas and fluid containment components for pervasive Air Force a Tested new methods for rapid fabrication of micron-scale three-dimensional strudevices. Evaluated the use of hybrid thin wires for Air Force aerospace components | esistant applications and evaluated aerospace subcomponent applications. actures for Air Force micromechanical | | | | |
| Project 4347 R-1 Shopping | List - Item No. 4-4 of 4-20 | | Exhibit R-2a (F | | |

| Exhibit R-2a, RDT&E Project Justification | | | | TE February 2004 | | |
|---|--|-----------|--|---------------------|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602102F Materials | 4347 Mate | MBER AND TITLE ials for Structures, , and Subsystems | | | |
| light-absorbing polymeric materials for incorporation into sensor protecti methods for room temperature cure of resins for advanced Air Force com conductive materials for low-observable gap sealants in Air Force aircraft | posite applications. Evaluated the use of tapplications. | | | | | |
| (U) In FY 2004: Test clay infiltrated nanostructured polymeric materials for i rapid fabrication of nanoscale three-dimensional structures for Air Force electromechanical applications. Test hybrid thin wires under rigorous en mechanical stresses. Scale up and complete advanced evaluation of two for night vision goggle protection. Develop the curing process for and in advanced resins. Develop nanostructured polymer materials for low-obse applications. | conducting, structural, and vironmental conditions and extreme photon absorbing (TPA) polymer materials itiate testing of composites containing | | | | | |
| (U) In FY 2005: Establish the enhanced performance of nanostructured polyr. Continue to develop techniques and materials for nanoscale architectures structural, and electromechanical applications. Complete development of Complete development of TPA polymer materials for night vision goggle durability of water borne conductive nanocomposites. Enhance conducti elimination of secondary conductive coatings for aircraft lighting strike p lightweight radio frequency polymer substrates for reduced aperture size, | to address advanced Air Force conducting, f a hybrid thin wire making process. e and sensor protection applications. Test the ve polymeric nanocomposites for use in protection. Show the feasibility of | | | | | |
| (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop affordable, adva materials and technologies for Air Force systems applications including l subcomponents and other structures requiring thermal and/or structural m In FY 2003, this effort includes Congressional Adds of \$3.25 million for Thermal Management for Military Aircraft and Space Structures, \$1.25 m Unmanned Aerial Vehicles, and \$0.5 million for Composite Materials Tr- includes Congressional Adds of \$1.5 million for Composite Materials for Initiative and \$4.0 million for Wright Brothers Institute - Nanostructured | nced organic matrix composite structural ightweight structures for aerospace nanagement for environmental control. Note: Nanostructured Materials, \$1.3 million for nillion for Cost-effective Materials for aining Program. In FY 2004, this effort Unmanned Aerial Vehicles (UAV) | 13.690 | 13.170 | 9.006 | | |
| (U) In FY 2003: Developed composite material degradation mechanisms to in environmental control systems, hot exhaust-washed structures, and engin high temperature organic matrix composites for aerospace platforms. Im novel product foams such as nanomaterials, nanotubes, and carbon foams structural materials. | mprove life prediction for aircraft e components. Developed next generation proved the processing and fabrication of | | | | | |
| (U) In FY 2004: Continue to develop an understanding of degradation mecha aircraft turbine engine and exhaust-washed structures as a function of the processing, and fabrication scale-up of high-temperature organic matrix of | ir environments. Validate materials, | | | | | |
| Project 4347 R-1 S | hopping List - Item No. 4-5 of 4-20 | | Exhibit R-2a (F | PE 0602102F) | | |

| Exhibit R-2a, RDT&E Project Justification | | | DATE | | |
|---|--|-----------|--|--------------|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602102F Materials | 4347 Mate | February 2004 ECT NUMBER AND TITLE Materials for Structures, ulsion, and Subsystems | | |
| high-Mach vehicle applications. Evaluate nanomaterials technologies military aircraft and satellites. Evaluate innovative carbon materials, s techniques for aircraft thermal management applications. | | | | | |
| (U) In FY 2005: Test life prediction capabilities for high temperature turbi Optimize materials and processing scale-up of high temperature organi aircraft structures, and high-Mach vehicles. Develop materials and pro- and/or high performance composites with tailored and multi-functional the subcomponent level for improved reliability and performance of th | ic matrix composites for affordable turbine, presses for nanomaterials as matrix additives l capabilities. Test materials and processes at | | | | |
| (U) | ermai management appreation. | | | | |
| (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop nonstructural and corrosion resistant coatings, and specialty treatments to improve sy Note: In FY 2003, this effort includes Congressional Adds of \$1.0 milli \$2.8 million for Durable Coatings for Aircraft Systems, and \$1.0 milli Coatings. In FY 2004, this effort includes a Congressional Add of \$1 Aircraft Systems. | ystem performance and reduce life cycle costs. lion for Nanostructures Protective Coatings, on for Environmentally Sound Aircraft | 11.054 | 8.095 | 7.621 | |
| (U) In FY 2003: Developed electrically conductive elastomers for use in el Developed advanced analytical techniques to predict the optical proper for permanent corrosion-resistant primer resins and environmentally sa Established baseline for nanostructured multi-functional coatings to co environments. Developed surface treatments for friction, stiction, and | ties of specialty coatings. Established criteria afe corrosion protection with a 30-year life. ntrol friction and wear in extreme | | | | |
| (U) In FY 2004: Formulate the most promising electrically conductive elass control gap treatments. Continue to develop advanced analytical techr specialty coatings. Investigate non-chromate surface treatments with a corrosion protection systems. Develop environmentally friendly corro expectancy. Evaluate nanostructured multi-functional coatings to cont Refine candidate surface treatments for friction, stiction, and wear con status monitoring techniques for hydraulic fluids and related subsysten condition-based maintenance procedures. Identify materials technolog resistant electronics. | iques to predict the optical properties of dvanced performance coatings for aircraft sion protection systems with a 30-year life rol friction and wear in extreme environments. trol in micro-devices. Investigate potential as to extend aircraft life and establish | | | | |
| (U) In FY 2005: Fabricate candidate materials for use in electrostatic disch advanced analytical models that will be used to predict the optical prop data. Evaluate the non-chromate surface treatments with advanced per protection systems. Continue to develop environmentally friendly corr expectancy. Design and develop nanostructured multi-functional coatients. | berties of specialty coatings based on measured formance coatings for aircraft corrosion cosion protection systems with a 30-year life | | | | |
| Project 4347 R- ⁻ | Shopping List - Item No. 4-6 of 4-20 | | Exhibit R-2a (I | PE 0602102F) | |

| Exhibit R-2a, RDT&E Project Justification | | | February | 2004 |
|--|--|-----------|--|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602102F Materials | 4347 Mate | PROJECT NUMBER AND TITLE 4347 Materials for Structures, Propulsion, and Subsystems | |
| environments. Fabricate and test surface treatments for friction, stiction, candidate in situ status monitoring techniques for hydraulic systems to ex condition-based criteria for repair or replacement. Evaluate material and/ and/or tamper resistant electronics. | tend aircraft life and establish | | | |
| (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop affordable lightw prediction technologies, higher temperature intermetallic alloys, and meta performance, lower acquisition costs, increased durability, and improved Note: In FY 2003, this effort includes Congressional Adds of \$4.4 million million for Metals Affordability Initiative. In FY 2004, this effort include Discontinuous Titanium Matrix Composites for Aerospace Applications a Composites Program. | als processing technology to enable enhanced reliability for Air Force weapon systems. In for Titanium Matrix Composites and \$5.3 es Congressional Adds of \$1.0 million for | 26.070 | 17.650 | 13.690 |
| (U) In FY 2003: Transitioned life prediction methodology and surface treatme damage in integrally bladed rotors. Developed processing methods for see achieving a 300°F temperature capability increase over current turbine bl methods for modeling the mechanical properties of specific metallic alloy affordable process technologies to enable more affordable production of or Force aerospace vehicles. | econd-generation alloys with the potential of ade materials. Developed computational vs. Optimized and transitioned advanced | | | |
| (U) In FY 2004: Initiate development of new life prediction technologies for durability in thermal-mechanical fatigue design systems. Continue to dev high-temperature structural materials that are nickel- and molybdenum-ba Develop computational methods for modeling mechanical properties of n that they can be used to reduce the amount of proof testing required to rel | velop and analyze second-generation ased for turbine engine applications. netals and alloys and validate these tools so ease metals for final component production. | | | |
| Identify processes and protocols for unitized manufacturing of aerospace (U) In FY 2005: Develop reliable life extension capabilities for turbine engine high-temperature structural materials through preliminary certification temperature of matter computational methods of modeling mechanical propenable cost and schedule savings due to reduced amount of proof and releptotocols for unitized manufacturing of aerospace components. | e rotors. Evaluate performance of sting and/or ground based engine rig testing. perties to metal suppliers and vendors to | | | |
| (U) Total Cost | | 65.429 | 64.131 | 41.057 |
| Project 4347 R-1 S | hopping List - Item No. 4-7 of 4-20 | | Exhibit R-2a (| PE 0602102F) |
| | 65 | | | |

| | UNCLASSIFIED | |
|---|---|--|
| Exhibit R-2a, RDT&E | Project Justification | DATE February 2004 |
| BUDGET ACTIVITY D2 Applied Research | PE NUMBER AND TITLE 0602102F Materials | PROJECT NUMBER AND TITLE 4347 Materials for Structures, Propulsion, and Subsystems |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | |
| U) D. Acquisition Strategy Not Applicable. | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Project 4347 | R-1 Shopping List - Item No. 4-8 of 4-20 | Exhibit R-2a (PE 06021 |

| | Ext | nibit R-2a, I | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|---|--|---|---|--|---|--|--|--|---|-------------------------------------|
| | ET ACTIVITY oplied Research | | | | PE NUMBER AND 0602102F Mat | | | 4348 Materia | BER AND TITLE | nics, |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| 4348 | Materials for Electronics, Optics, and Survivability | 18.253 | 19.252 | 12.437 | 11.716 | 12.080 | 12.444 | 12.728 | | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| space (U) | In FY 2003, space unique tasks in Project unique activities. A. Mission Description and Budget Item This project develops materials technolog microwave, and infrared detection and con sensors, and aircraft from laser and high-p surveillance and situational awareness wit temperatures), greater sensitivity, and exter and agile threat wavelengths without impa | n Justification ies for surveilla untermeasures o ower microwa h faster operati ended dynamic | nce and situati devices used for ve directed ene ng speeds, grea range. New m | ional awareness or targeting, ele orgy threats are ater tunability, | s systems and so ctronic warfare also developed higher power o | ubsystems for a , and active air . Electronic an utput, improved | ircraft and mis craft protection d optical mate l thermal man | ssile applicatio n. Materials fo rials are being agement (inclu | ns, including ser r protection of a developed to en ding higher oper | nsor, ircrews, able rating |
| (U) N t | B. Accomplishments/Planned Program (MAJOR THRUST: Develop, evaluate, and echnologies to enable improved performar racking, targeting, and situational awarene | mature infrare nce, affordabilit | . , | | 1 | U | <u>F</u> Y | <u>7 2003</u> 2.885 | <u>FY 2004</u> 0.472 | <u>FY 2005</u> 0.500 |
| t c r (U) I v r c c (U) I v v v r c c v v v v v v v v v v v v v v | n FY 2003: Developed the process control o multiple wavelengths within and betwee letector materials yield and affordability in eal-time tracking capability. n FY 2004: Validate the military utility of vithin and between spectral bands. Exploi naterials performance and improve militar letector materials that require control on an ano-scale materials solutions for detectors hemical threats. n FY 2005: Continue development of com vithin and between spectral bands. Valida ontrol on an atomic level to structure their | n spectral band small lots. Inv complex IR de t validated proc y utility. Show atomic level to for a broad rar plex IR detecto te the materials | s. Transitioned vestigated IR d tector material cessing techniq the process co o structure their age of Air Force or materials that properties of o | d new processin etector materia s that are respo- ues to develop ontrol required ir detection pro- ce sensing need t are responsive complex IR det | ng techniques to ls that provide onsive to multip enhanced IR de for growth of co perties. Investi s including the e to multiple wa ector materials | o improve IR enhanced le wavelengths etector omplex IR gate potential detection of avelengths that require | | | | |
| | s potential IR materials for a broad range | | | | | | | | | |
| Proje | ct 4348 | | R-1 S | Shopping List - Ite | em No. 4-9 of 4-20 |) | | | Exhibit R-2a (I | PE 0602102F) |
| | | | | 67 | | | | | | |

| Exhibit R-2a, RDT& | E Project Justification | | DATE | | | | |
|---|---|-------|-----------------|--------------|--|--|--|
| | February | 2004 | | | | | |
| BUDGET ACTIVITY 02 Applied Research | | | | | | | |
| (U) | | | | | | | |
| (U) MAJOR THRUST: Develop, evaluate, and mature materials techn aircrews and related assets against heat seeking infrared (IR) missi (U) In FY 2003: Developed growth and processing techniques for larg mid-IR laser radiation for future IR countermeasures (IRCM). Inc | les and laser threats. e nonlinear crystals for generating higher power | 5.240 | 4.925 | 5.840 | | | |
| into candidate host materials and tested their performance in the A of personnel eyes, viewing systems, and night vision goggles. | | | | | | | |
| (U) In FY 2004: Investigate growth and processing techniques for non and nanostructuring for generating laser radiation with significantl Optimize the performance of promising nonlinear absorbing mater improved performance in the Air Force Optical Limiting Testbed for systems, and night vision goggles. | y higher energy per pulse for future IRCM. ials in candidate host materials and test their | | | | | | |
| (U) In FY 2005: Develop growth and processing techniques for nonlin generating laser radiation with significantly higher energy per puls of the optimized nonlinear absorbing materials in candidate host m the protection of personnel eyes, viewing systems, and night vision | e for future IRCM. Characterize the performance aterials and document the test results obtained for | | | | | | |
| (U) | | | | | | | |
| (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and evaluation generation, power control, and microwave components to provide operational capability for Air Force surveillance, tracking, targetin weapon systems. Note: In FY 2003, this effort includes Congressin Deposition for Semiconductor Nanotechnology, \$2.1 million for F million for Advanced Wide Bandgap Material Technology. In FY \$2.6 million for Advanced Wide Bandgap Materials and \$1.7 million Material Development. | improved performance, affordability, and g, situational awareness, and lethal and non-lethal onal Adds of \$1.1 million for Advanced Materials ree Electron Laser Materials Processing, and \$3.4 2004, this effort includes Congressional Adds of on for Gallium Nitride Microelectronics and | 9.195 | 8.300 | 4.225 | | | |
| (U) In FY 2003: Evaluated materials and materials processing technological reliability and temperature capability, while reducing power consult Furthered the development and maturation of materials and materials performance for power control systems, advanced radar, and electral assessment of materials and materials process technologies for ultral generators enabling airborne lethal and non-lethal directed energy | mption, weight, cost, cooling, complexity, and size. als processes to provide presently unattainable onic countermeasures. Began scale-up and a-lightweight, ultra-high-power aircraft electrical weapons in fighter-sized aircraft. | | | | | | |
| (U) In FY 2004: Continue evaluation of materials and materials process systems reliability and temperature capability, while reducing power and size. Continue development and testing of materials and process. | er consumption, weight, cost, cooling, complexity, | | | | | | |
| Project 4348 | R-1 Shopping List - Item No. 4-10 of 4-20 | | Exhibit R-2a (F | PE 0602102F) | | | |
| | 68 | | | | | | |

| Exhibit R-2a, RDT&E | Project Justification | DA | February | 2004 |
|---|---|-----------|---|---------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602102F Materials | 4348 Mate | IMBER AND TITLE rials for Electro d Survivability | onics, |
| for power control systems, advanced radar, and electronic counterm baseline materials and materials process technologies for ultra-light generators enabling airborne lethal and non-lethal directed energy w and materials process technologies for Terahertz components to pro magnitude leap in speed of Air Force sensor and communication systems reliability and temperature capability, while reducing powe and size. Investigate advanced materials and materials processing to achievable with baseline materials. Optimize and scale-up material unattainable performance for power control systems, advanced rada assessment of baseline materials and materials process technologies electrical generators enabling airborne lethal and non-lethal directed. Develop advanced materials and materials process technologies to prelative to baseline materials of provide the bandwidth required for the new sensor and communication systems. | weight, ultra-high-power aircraft electrical weapons in fighter-sized aircraft. Explore materials wide the bandwidth required for the next order of stems. essing technologies to enable increased Air Force er consumption, weight, cost, cooling, complexity, echnologies to provide capabilities beyond those s and materials processes to provide presently ur, and electronic countermeasures. Complete s for ultra-lightweight, ultra-high power aircraft d energy weapons in fighter-sized aircraft. provide improvements and additional capabilities rials and materials process technologies for | | | |
| (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and mature survivability and mission effectiveness of Air Force sensors, viewin threats. In FY 2004, this effort includes Congressional Adds of \$1. Development and \$2.8 million for Ultraviolet Free Electron Laser (1) Microfabrication. | ng systems, and night vision goggles against laser 0 million for Computational Tools for Material | 0.933 | 5.555 | 1.872 |
| (U) In FY 2003: Developed liquid crystal materials employed in autono wavelengths. Developed high optical density, multiple wavelength (U) In FY 2004: Validate the performance of liquid crystal materials em near-IR wavelengths. Fabricate laboratory samples of high optical ostacks. | switchable filter stacks. pployed in autonomous tunable filters to block | | | |
| (U) In FY 2005: Design a representative brassboard protection system in crystal-based autonomous tunable filters. Characterize the optical p wavelength switchable filter stacks. (U) Total Cost | | 18.253 | 19.252 | 12.437 |
| Project 4348 | R-1 Shopping List - Item No. 4-11 of 4-20 | | Exhibit R-2a (| (PE 0602102F) |

| | | Exhibit R- | -2a, RDT&E | Project Ju | stification | | | DA | TE February | 2004 | |
|-------|---|--------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|--|-----------------|------------|--|
| | GET ACTIVITY Applied Research | | | 0602102F Materials | | | | PROJECT NUMBER AND TITLE 4348 Materials for Electronics, Optics, and Survivability | | | |
| (U) | C. Other Program Funding Sum | <u>mary (\$ in Milli</u> | ons) | | | | | | | | |
| | | FY 2003 Actual | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | | Total Cost | |
| (U) | Related Activities: | | | | | | | | | | |
| . , | PE 0603112F, Advanced | | | | | | | | | | |
| (U) | Materials for Weapon Systems. | | | | | | | | | | |
| (U) | PE 0602202F, Human | | | | | | | | | | |
| (0) | Effectiveness Applied Research. | | | | | | | | | | |
| (U) | PE 0602204F, Aerospace | | | | | | | | | | |
| l` í | Sensors. PE 0603231F, Crew Systems | | | | | | | | | | |
| (U) | and Personnel Protection | | | | | | | | | | |
| (0) | Technology. | | | | | | | | | | |
| | PE 0603211F, Aerospace | | | | | | | | | | |
| (U) | Technology Dev/Demo. | | | | | | | | | | |
| | PE 0602500F, | | | | | | | | | | |
| (U) | 1 2 1 | | | | | | | | | | |
| | Technology. | | | | | | | | | | |
| | This project has been | | | | | | | | | | |
| (T.D. | coordinated through the | | | | | | | | | | |
| (U) | Reliance process to harmonize efforts and eliminate | | | | | | | | | | |
| | duplication. | | | | | | | | | | |
| | - | | | | | | | | | | |
| (U) | D. Acquisition Strategy | | | | | | | | | | |
| | Not Applicable. | | | | | | | | | | |
| | | | | | | | | | | | |
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| 1 | | | | | | | | | | | |
| | oject 4348 | | |) 1 Chonging List | - Item No. 4-12 of 4 | 20 | | | Exhibit R-2a (F | | |

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 | | |
|------------|--|---|---|---|---|---|---|---|--|-------------------------|-------|-------|
| | GET ACTIVITY pplied Research | | | | E NUMBER AND | BER AND TITLE | | | | | | |
| | Cost (\$ in Millions) FY 2 Act | | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total | | |
| 4349 | Materials Technology for Sustainment | | | | | | | 17.503 | | 17.916 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| (U) | A. Mission Description and Budget Item This project develops materials and material delivered systems, transitioning more relia characterizing materials processes and pro- and repair centers. Repair techniques and coatings, corrosion control processes, and quality in the design and production of air service-initiated damage and/or deterioration | ials processing able and mainta operties necessa nondestructive to support integ craft, propulsio | inable material ry for material inspection/eva gration of comp n, and missile | ls, establishing s transition, and aluation (NDI/E posite structure systems. These | a capability to d providing qui E) methods are as for aerospace | detect and char ck reaction sup developed that systems. Vari | acterize perform port and failure are needed for ous NDI/E met | mance threaten e analysis to the metallic and no hods are essent | ing defects, e operational co on-metallic struc tial to ensure op | mmands ctures, | | |
| (U) (U) | B. Accomplishments/Planned Program (MAJOR THRUST: Develop NDI/E techno propulsion systems, and complex, low-obse In FY 2003: Developed inspection methods methods to rapidly detect and characterize a computer simulations and models of NDI/E inspections in a virtual environment to perr detection NDI/E methods. Evaluated NDI/ and after application. Researched residual | logies to identitiervable (LO) m s for aging aero multi-site dama E technique resp nit the depots to E methods to c | aterials and str space structure ge and cracks onse, which w o rapidly assess naracterize the | uctures. es and propulsio in large area, ag vill enable the d s the potential o LO properties | on systems. Ev ging structures. levelopment of of new corrosio of paints and co | aluated Evaluated improved n and crack patings during | | <u>2003</u> 4.769 | <u>FY 2004</u> 3.386 | <u>FY 2005</u> 3.788 | | |
| (U) | subsurface measurement on shot peened su In FY 2004: Improve methods to inspect ar systems. Develop electromagnetic method large-area, aging structures. Develop comp enable the development of improved inspec potential of new corrosion and crack detect electromagnetic material properties beneath characterize damage in repaired (linear fric gradient measurement capability for selecte shot peened surfaces. In FY 2005: Evaluate electromagnetic meth | nd maintain the s to rapidly dete- buter simulation ctions in a virtu ion NDI/E meth n dielectric tiles tion welded) ad ed turbine engin | ect and charact is and models of al environment nods. Evaluate in LO applica vanced engine e materials to | erize multi-site of NDI/E techn t to permit the of technology co tions. Identify components. I increase measu | damage and cr ique response, depots to rapidly oncepts for meas methods to det Develop residua rement depth c | acks in which will y assess the suring complex ect and al stress apabilities on | | | | | | |
| | ect 4349 | | | | m No. 4-13 of 4-2 | | | | Exhibit R-2a (F | PE 0602102F) | | |
| | | | | 71 | | | | | | / | | |

| | Exhibit R-2a, RDT&E Projec | ct Justification | ſ | February | 2004 |
|------------|---|---|-------|---|--------------|
| | GET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602102F Materials | | NUMBER AND TITLE terials Technolog nent | ly for |
| | large area, aging structures. Evaluate computer simulations and models of N enable the development of improved inspections in a virtual environment to potential of new corrosion and crack detection non-destructive inspection/eva sensor technologies for measuring complex electromagnetic material propert development of a residual stress gradient measurement capability for selected surfaces. | permit the depots to rapidly assess the aluation (NDI/E) methods. Develop ties beneath dielectric tiles. Continue | | | |
| (U) (U) | MAJOR THRUST: Develop enabling low-observable (LO) requirements tec maintenance burden. | chnologies to reduce the Air Force | 2.426 | 3.765 | 4.047 |
| (U) | In FY 2003: Validated capability for NDI/E point inspection devices and ver integrated LO repair kit that includes conductive gap fillers, radar absorbing removal equipment, radar absorbing structure (RAS) repair materials, and NI | material (RAM) repair materials, RAM | | | |
| (U) | In FY 2004: Complete development of NDI/E point inspection device capability kit for use on multiple aircraft systems, which will result in standardization of conductive gap fillers, RAM repair materials, RAM removal equipment, RAM and software. | ility. Develop a standardized LO repair of aircraft repair processes that includes | | | |
| | In FY 2005: Optimize technologies for an integrated, standardized LO repair RAM repair materials, RAM removal equipment, RAS repair materials, and | • • | | | |
| (U) (U) | MAJOR THRUST: Develop support capabilities, information, and processes materials and provide electronic and structural failure analysis of component | - | 3.833 | 3.681 | 4.040 |
| (U) | In FY 2003: Performed failure analysis and materials investigations for field, Certified and transitioned emerging electrostatic discharge protection materia applications. Evaluated testing techniques needed for analyzing structural fa Air Force systems. | , acquisition, and depot organizations. als technologies and techniques for LO | | | |
| (U) | In FY 2004: Continue performing failure analysis and materials investigation organizations. Develop electrostatic discharge protection technologies for er new test methodologies for analyzing structural failures of replacement mate Investigate materials technologies effort to replace aging wiring in Air Force | merging avionics subsystems. Develop rials for aging Air Force systems. | | | |
| (U) | In FY 2005: Continue performing failure analysis and materials investigation organizations. Validate electrostatic discharge protection technologies for er new test methodologies for analyzing structural failures of replacement mate Develop materials technologies effort to replace aging wiring in Air Force ai | merging avionics sub-systems. Validate rials for aging Air Force systems. | | | |
| (U) | | · | | | |
| Pro | oject 4349 R-1 Shopp | bing List - Item No. 4-14 of 4-20 | | Exhibit R-2a (| PE 0602102F) |

| | Exhibit R- | 2a, RDT&E | Project Jus | | | | | DATE February | | |
|--|---|--|---|--|--|-----------------------------------|---------------|---|-------------------|--|
| BUDGET ACTIVITY 02 Applied Research | | | | PE NUMBER AND TITLE 0602102F Materials | | | | PROJECT NUMBER AND TITLE 4349 Materials Technolog Sustainment | | |
| (U) MAJOR THRUST: Develop supp materials in the repair of aircraft s (U) In FY 2003: Published residual stublade materials. Transitioned adv metallic materials for high-energy corrosion and erosion resistance o Published baseline for improved c | tructures and to re resses baseline crit anced composite r chemical oxygen f new and emergin corrosion managen | duce aircraft con teria of high cyc naterials compat- iodine laser dev ng materials used nent procedures. | rrosion. le fatigue foreig tibility with lase vices. Establishe d in operationall | n object damage r effluents as an ed capabilities to y fielded Air Fo | in turbine engir alternative to evaluate rce systems. | | 5.905 | 5.372 | 5.950 | |
| (U) In FY 2004: Develop and evaluate materials used in operationally fie Systems (MEMS) used in hybrid, (U) In FY 2005: Mature methodologie | lded Air Force sys multifunctional, o | stems. Identify f | failure mechanis ing structures an | ms in Micro-Ele d subsystems. | ectro-Mechanica | l | | | | |
| in operationally fielded Air Force subsystems.(U) Total Cost | | | | | | | 16.933 | 16.204 | 17.825 | |
| (U) C. Other Program Funding Sur (U) Related Activities: PE 0603112F, Advanced Materials for Weapons Systems. (U) PE 0603211F, Aerospace Technology Dev/Demo. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) D. Acquisition Strategy Not Applicable. | nmary (\$ in Milli <u>FY 2003</u> <u>Actual</u> | ons) <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | FY 2 Estir | | <u>Total Cost</u> | |
| Project 4349 | | F | | - Item No. 4-15 of - 73 | 4-20 | | | Exhibit R-2a | (PE 0602102F) | |

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justifi | ication | | | | DATE | February | 2004 |
|-------------------|---|---|---|---|--|---|---------------------|------------------------|-------|--------------------------------|-------------------------|
| | GET ACTIVITY Applied Research | | | | E NUMBER AND | | | | | BER AND TITLE ed Air Base T | echnology |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2 Estin | | Cost to Complete | Total |
| 491 | 5 Deployed Air Base Technology | 3.367 | 9.635 | 2.341 | 2.394 | 2.458 | 2.521 | | 2.583 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | |
| (U) | <u>A. Mission Description and Budget Iten</u> This project supports the Aerospace Exper requirements, setup times, and sustainmen developed for base infrastructure, fire figh | ditionary Forces at costs, and to i | mprove protec | tion and surviv | ability of deplo | | | | | | |
| (U) (U) (U) | B. Accomplishments/Planned Program (MAJOR THRUST: Developed affordable, missions, support weapon systems sustainn cost-effective disposal of problem AEF wa remaining activities in this thrust will be in In FY 2003: Developed affordable, deploya missions, support weapon systems sustainn problem AEF wastes for low-observable m In FY 2004: Not Applicable. In FY 2005: Not Applicable. | deployable tech nent, and ensure stes for low-obs tegrated into the able technologie nent, and ensure | e deployablity. servable materi e other major th es to ensure mi e deployablity. | Enhanced dev al waste treatm hrusts in this pr litary readiness | relopment of sat nent. Note: In F roject. s, maintain aero | Se, SY 2004, space | ΕY | <u>7 2003</u> 0.101 | | <u>FY 2004</u> 0.000 | <u>FY 2005</u> 0.000 |
| (U) | MAJOR THRUST/CONGRESSIONAL Al manpower requirements, setup times, and s effort includes a Congressional Add of \$1.2 effort includes half of a Congressional Add Development. In FY 2003: Developed deployable fuel cell decrease maintenance, increase mean time costs. In FY 2004: Mature deployable fuel cell po of high-efficiency solid state solar cell tech | ustainment cost 2 million for Ty l of \$2.4 million l, solar power, a between failure ower system to a | ts in support of ndall Air Force for Tyndall A and heat pump , increase oper- advanced techn | AEF operation e Research Lab ir Force Resear technologies th ating efficiency tology develop | ns. Note: In FY poratory. In FY rch Laboratory hat increase per y, and reduce su ment. Continue | 2003, this 2004, this Research and formance, stainment e development | | 1.794 | | 2.240 | 1.173 |
| Pro | shelter/utility system that will integrate fue efficient, individual systems for deployable rapid airfield expansion that will reduce the Initiate research on catalysis and degradation bject 4915 | e shelters. Initia e time required | te research on to prepare aircr materials that | polymer-clay s raft operating s will provide cle | stabilization tech urfaces at conti | hnology for ngency bases. cost advanced | | | | Exhibit R-2a (I | PE 0602102E) |
| | | | 11 101 | | | | | | | | |

| Exhibit | R-2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|---|--|--|--|---|---------------------|---------------------|---------------------|---------------|
| BUDGET ACTIVITY 02 Applied Research | | | PE NUMBER A 0602102F N | | | PROJECT NUMI | BER AND TITLE | |
| materials. (U) In FY 2005: Develop high-efficiency solid state s power/Heating, Ventilation, and Air Conditioning technologies into a highly efficient compact syste for individual deployable shelters. Develop polyr reduce time to prepare aircraft operating surfaces degradation technologies of Air Force materials the statement of the systement of the systement | concepts that wil m that can provid- ner-clay stabilizat at unimproved co | l integrate fuel c e total energy an ion agents for ra ntingency bases. | ell, solar and head d air conditionin pid airfield expa Evaluate cataly | at pump og requirements nsion that will vsis and | | - | | |
| (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: D survivability to Aerospace Expeditionary Forces of this effort includes Congressional Adds of \$1.4 m Fire Safety Consortium, \$2.3 million for Thermal Tyndall Air Force Research Laboratory Research | (AEF) deployed w iillion for Closed (Sprays for Struct | varfighters and in Cell Foam Mater ural Protection, a | frastructure. No ials, \$1.5 million | n for Composite | | 1.472 | 7.395 | 1.168 |
| (U) In FY 2003: Developed atmospheric threat predic personnel from toxic industrial materials. Develo advanced blast protection materials to protect dep | tion models and d pped effective adva loyed warfighters | eployable sensor anced fire fightin | g agents and eq | uipment and | | | | |
| (U) In FY 2004: Continue development of fire fightin equipment and advanced blast protection material polymer-based retrofit technologies for expedition | s to protect deploy nary and permane | yed warfighters. | Develop and ev rotect the warfig | aluate hter. | | | | |
| (U) In FY 2005: Develop effective advanced fire figh to protect deployed warfighters. Initiate research laser weapons systems. Initiate research on resili- structures and inhabitants. | on chemical laser | fire suppression | agents for effec | tive protection of | f | | | |
| (U) Total Cost | | | | | | 3.367 | 9.635 | 2.341 |
| (U) <u>C. Other Program Funding Summary (\$ in M</u> | <u>illions)</u> | | | | | | | |
| FY 2003 Actual | <u>FY 2004</u> Estimate | FY 2005 Estimate | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total Cost |
| (U) Related Activities: | Estimate | Littilde | Linade | Listinate | Linnate | Listinate | <u>complete</u> | |
| (U) PE 0603112F, Advanced Materials for Weapon Systems. This project has been | | | | | | | | |
| (U) coordinated through the Reliance process to harmonize efforts and eliminate | | | | | | | | |
| Project 4915 | | R-1 Shopping List | Item No. 4-17 of | 4-20 | | | Exhibit R-2a | (PE 0602102F) |

| | UNCLASSIFIED | |
|--|---|---|
| Exhibit R-2a, RI | DT&E Project Justification | DATE February 2004 |
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602102F Materials | PROJECT NUMBER AND TITLE 4915 Deployed Air Base Technology |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> duplication. | | |
| (U) D. Acquisition Strategy Not Applicable. | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Project 4915 | R-1 Shopping List - Item No. 4-18 of 4-20 76 | Exhibit R-2a (PE 0602102F) |

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|-------------------|--|---|---|--|--|--|---|--|-------------------------------------|-------------------|
| | GET ACTIVITY Applied Research | | | | PE NUMBER AND | | | | BER AND TITLE | chnology |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 5015 | 22 | 1.255 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | 0.00 |
| | Quantity of RDT&E Articles :: In FY 2003, civilian salaries associated wi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) (U) (U) | A. Mission Description and Budget Item This project develops advanced pervasive and reliability of current and future aerosp lightweight ducts, turbo pumps, injectors, cost-reduction enhancements for overall a for new materials application using repres B. Accomplishments/Planned Program (MAJOR THRUST: Develop and evaluate p components and sub-components to dramate future Air Force aerospace systems. | n Justification materials and p bace engine app and nozzles su erospace engine entative geome \$ in Millions) bervasive mater tically improve | processing tech lications. The b-systems. The e applications. try and process ials and process affordability, p | nologies for ae components of e material adva This project w ing conditions sing technolog performance, an | erospace propul f liquid-fuel eng uncements in the vill develop mat for the intende gies for aerospace nd reliability of | sion technologi gines that advar ese aerospace s terial property o d aerospace eng ce engine c current and | es to dramatica aced materials o ystems will pro latabases and i gine componer <u>FY</u> | ally improve at can significant ovide lighter w nitiate the dem | ly impact inclue eight, performa | le nce, and |
| (U) (U) | In FY 2003: Evaluated chemistry/heat treat housing components. Identified and develo missile applications. Identified and evaluat high performance monopropellants for aero In FY 2004: Not Applicable. In FY 2005: Not Applicable. Total Cost | oped pervasive ted pervasive h | zero erosion m igh temperature | aterials for mu | ltiple aerospace | e engine and | | 1.255 | 0.000 | 0.000 |
| (U) | C. Other Program Funding Summary (S | <u>6 in Millions)</u> | | | | | | | | |
| | | | | <u>Y 2005</u> Estimate | FY 2006 Estimate | FY 2007 Estimate | <u>FY 2008</u> <u>Estimate</u> | FY 2009 Estimate | <u>Cost to</u> Complete | <u>Total Cost</u> |
| Pro | ject 5015 | | R-1 St | ioppina List - Iter | m No. 4-19 of 4-2 | 0 | | | Exhibit R-2a (| PE 0602102F) |
| 1.10 | 100,0010 | | 11 10 | 77 | | | | | | |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2004 |
|---|---|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602102F Materials | PROJECT NUMBER AND TITLE 5015 Rocket Materials Technology |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Multi-Disciplinary Space Technology. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. | | |
| (U) D. Acquisition Strategy Not Applicable. | | |
| | | |
| Project 5015 | R-1 Shopping List - Item No. 4-20 of 4-20 78 | Exhibit R-2a (PE 0602102F) |

PE NUMBER: 0602201F PE TITLE: Aerospace Vehicle Technologies

| | Exhit | oit R-2, RDT | 「&E Budge | t Item Just | ification | | | DATE | February | 2004 |
|----------|--|-----------------|----------------|-------------|--|-----------------|------------------|----------------|--------------|-------|
| | r activity Dlied Research | | | | PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies | | | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ III Millions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| | Total Program Element (PE) Cost | 75.067 | 64.311 | 74.679 | 103.895 | 111.893 | 105.771 | 108.164 | Continuing | TBD |
| 2401 | Structures | 26.267 | 28.679 | 32.831 | 43.196 | 46.599 | 41.726 | 42.646 | Continuing | TBD |
| 2403 | Flight Controls and Pilot-Vehicle Interface | 16.777 | 15.486 | 16.643 | 30.324 | 33.315 | 28.784 | 29.589 | Continuing | TBD |
| 2404 | Aeromechanics and Integration | 32.023 | 20.146 | 25.205 | 30.375 | 31.979 | 35.261 | 35.929 | Continuing | TBD |
| 4397 | Air Base Technology | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | Continuing | TBD |
| Note: Ir | FY 2003, only the space unique efforts | in Project 2403 | transferred to | PE 0602500E | Project 5030 i | n conjunction v | vith the Space (| Commission red | commendation | to |

Note: In FY 2003, only the space unique efforts in Project 2403 transferred to PE 0602500F, Project 5030, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description and Budget Item Justification

This program investigates, develops, and analyzes aerospace vehicle technologies in the three primary areas of structures, controls, and aeromechanics. First, advanced structures concepts are explored and developed to exploit new materials, fabrication processes, and design techniques. Second, flight control technologies are developed and simulated for both manned and unmanned aerospace vehicles. Third, the aeromechanics of advanced aerodynamic vehicle configurations are developed and analyzed through simulations, experiments, and multidisciplinary analysis. Resulting technologies reduce life cycle costs and improve the performance of existing and future manned and unmanned aerospace vehicles. Note: In FY 2004, Congress added \$1.1 million for intelligent flight control simulation research laboratory. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary aerospace vehicle technologies.

(U) **<u>B. Program Change Summary (\$ in Millions)</u>**

| | | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
|-----|----------------------------------|----------------|----------------|----------------|
| (U) | Previous President's Budget | 76.347 | 65.662 | 77.571 |
| (U) | Current PBR/President's Budget | 75.067 | 64.311 | 74.679 |
| (U) | Total Adjustments | -1.280 | -1.351 | |
| (U) | Congressional Program Reductions | | -2.000 | |
| | Congressional Rescissions | | -0.551 | |
| | Congressional Increases | | 1.200 | |
| | Reprogrammings | | | |
| | SBIR/STTR Transfer | -1.280 | | |
| (U) | Significant Program Changes: | | | |
| | None | | | |
| | | | | |
| | | | | |

R-1 Shopping List - Item No. 5-1 of 5-12

| | Ex | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 | |
|------------|---|---|---|---|---|--|---------------------|---------------------|---|-------------------------|--|
| | GET ACTIVITY Applied Research | | | C | PE NUMBER AND 602201F Aero Fechnologies | | le | | ROJECT NUMBER AND TITLE 401 Structures | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total | |
| 240 | 1 Structures | 26.267 | 28.679 | 32.831 | 43.196 | 46.599 | 41.726 | | Continuing | TBD | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| (U) | A. Mission Description and Budget Ite This project develops advanced structure Resulting technologies strengthen and ex weight and cost, as well as improved ope | es concepts to exp stend the life of c | urrent and futu | ire manned and | l unmanned aer | | | | | | |
| | B. Accomplishments/Planned Program MAJOR THRUST: Develop an economic | | lysis capability | comprised of | analysis tools, 1 | nethodologies, | <u>F</u> Y | <u>7.880</u> | <u>FY 2004</u> 7.170 | <u>FY 2005</u> 6.332 | |
| (U) | and monitoring schemes. In FY 2003: Developed economic service component replacement, and technology of multidisciplinary optimization methodolog future aerospace vehicles. Incorporated no software. | lirection. Contingies that enhance | ued developme affordability a | ent of unitized and decrease v | structural conce ulnerability for | epts and current and | | | | | |
| (U) | In FY 2004: Develop economic service li enhancing capabilities, component replace structural concepts and multidisciplinary r current and future aerospace vehicles. Inc analysis. Complete reliability based desig | ement, and techn methodologies th corporate newly o | ology direction at enhance affe developed anal | Continue the ordability and e ysis tools into | e development o decrease vulner life prediction a | of unitized ability for | | | | | |
| (U) | In FY 2005: Develop alternative methodo monitoring schemes for structures suscept service life analysis and structural design replacement, and technology direction. In analysis. Continue to develop failure crite Complete the development of unitized stru affordability and decrease vulnerability fo | blogies and conce ible to damage. tools for current acorporate newly eria tools for adv actural concepts | epts for structu Pursue additio and future airc developed ana anced high tem and multidiscij | ral repair. Dev nal aspects of r raft enhancing alysis tools for aperature aircra plinary method | velop structural the developmen capabilities, co life prediction a aft components | t of economic mponent and failure and concepts. | | | | | |
| (U) (U) | MAJOR THRUST: Develop methodolog cost and time involved in actual full-scale certification. | ies to allow for a | nalytical air-w | orthiness certif | | | | 4.203 | 7.743 | 6.550 | |
| Pro | ject 2401 | | R-1 S | hopping List - Ite | m No. 5-2 of 5-12 | | | | Exhibit R-2a (| PE 0602201F) | |
| | | | | 80 | | | | | | | |

| Exhibit R-2a, RDT&E | Project Justification | DA | TE February | 2004 |
|---|---|--------------------------|-----------------------------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies | PROJECT NU 2401 Struc | IMBER AND TITLE C tures | |
| (U) In FY 2003: Developed analytical certification methodologies for t and manufacturing technologies into legacy aircraft components an air-worthiness certification process for aircraft subjected to dynami (U) In FY 2004: Develop analytical certification methodologies for the discussion of the lease and have for the lease technologies for the | d future vehicle designs. Improved the c aeroelastic loads with high fidelity models. incorporation of advanced methods, concepts, | | | |
| diagnostic techniques, and manufacturing technologies into legacy the air-worthiness certification process for aircraft subject to dynam (U) In FY 2005: Continue to develop analytical certification methodole concepts, diagnostic techniques, and manufacturing technologies in Improve air-worthiness certification process for aircraft subject to do | nics laods and with high fidelity. Objects for the incorporation of advanced methods, to legacy aircraft components and airframe design. | | | |
| (U) | ignatine toads and with high fidenty. | | | |
| (U) MAJOR THRUST: Develop design methods to capitalize on new n hardware items (e.g., antennas and sensors) into the actual aircraft s | - | 2.101 | 5.736 | 5.424 |
| (U) In FY 2003: Continued development of structural concepts, design structure with other airframe functions to reduce cost and increase t included adaptive structures for varying moldline, subsystems hard bearing structure. | , analysis methods that enable the integration of he survivability of future systems. Concepts | | | |
| (U) In FY 2004: Develop concepts, design, and analysis methods and c with other air vehicle functions to reduce cost and weight, as well a Continue the development of concepts that include adaptive structur into a load-bearing structure to create multifunction or ultra lightwee | s increase the survivability of future systems. res, subsystem hardware, and antenna integration | | | |
| (U) In FY 2005: Refine concepts, design and analysis methods, and co with other air vehicle functions to reduce cost and weight, as well a Continue the development of concepts that include adaptive structur into a load-bearing structure to create multifunction or ultra lightwee | mponents that enable the integration of structures s increase the survivability of future systems. res, subsystem hardware, and antenna integration | | | |
| (U) | 6 | | | |
| (U) MAJOR THRUST: Develop technologies that will permit the struct extreme altitude while at sustained speeds greater than Mach 2. | tural development of aircraft that can operate at an | 12.083 | 8.030 | 14.525 |
| (U) In FY 2003: Developed technologies that incorporated advanced m withstand extreme flight environments. Concepts included advance systems, attachment techniques, vehicle health monitoring and heal systems, hot primary structures, hybrid structures, unitized structures tank structures. | ed, durable, all-weather thermal protection th management, integrated thermal protection | | | |
| (U) In FY 2004: Develop technologies that incorporate advanced mate withstand extreme flight environments. Complete the development | | | | |
| Project 2401 | R-1 Shopping List - Item No. 5-3 of 5-12 | | Exhibit R-2a (| PE 0602201F) |

| | Exhibit R- | 2a. RDT&E | Project Jus | stification | | | DAT | | |
|--|--|---|---|--------------------------------------|---------------------|---|----------------------------|-----------------------------------|-------------------|
| BUDGET ACTIVITY 02 Applied Research | | | PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies | | | PROJECT NUMBER AND TITLE 2401 Structures | | | |
| assessment. (U) In FY 2005: Continue to develop tecreation of an integrated air vehicle a development of concepts germane to techniques; vehicle health monitorin (U) Total Cost (U) C. Other Program Funding Summ | structure that can o advanced, all-v ag; hot primary s | n withstand extr veather, durable tructures; hybrid | eme flight envir , thermal protec | onments. Conti tion systems; atta | inue the achment | | 26.267 | 28.679 | 32.831 |
| (U) Related Activities: (U) PE 0602102F, Materials. PE 0603112F, Advanced Materials for Weapon Systems. PE 0603211F, Aerospace Technology Dev/Demo. (U) PE 0603333F, Unmanned Air Vehicle Dev/Demo. (U) PE 0604105F, Next Generation Bomber. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) D. Acquisition Strategy Not Applicable. | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> Estimate | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| Project 2401 | | | R-1 Shopping List | - Item No. 5-4 of 5 | -12 | | | Exhibit R-2a | (PE 0602201F) |

| | Ext | hibit R-2a, F | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|-------------------|---|--|--|--|---|--|--|---|--|---------------------------------|
| | GET ACTIVITY Applied Research | | | 0 | E NUMBER AND 602201F Aer echnologies | | le | PROJECT NUM 2403 Flight (Interface | BER AND TITLE | Pilot-Vehicle |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 2403 | Interface | 16.777 | 15.486 | 16.643 | 30.324 | 33.315 | 28.784 | 29.589 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | : In FY 2003, the space unique tasks in Pro- olidate all space unique activities. A. Mission Description and Budget Iter This project develops technologies that er developed for maximum vehicle performa towards the development of reliable autor warfighter include enhanced mission effect a network of synthetic environments for e | n Justification nable maximum ance throughout nomous unmann ctiveness, optim | affordable cap the flight enve ed air vehicles nized flight safe | bability from ma elope and simul s, space access s ety, increased s | anned and unm lated in virtual systems with ai | anned aerospac environments. rcraft-like oper | e vehicles. A Resulting tech ations, and ext | dvanced flight o mologies contri tended-life lega | control technolo bute significant cy aircraft. Pay | ogies are ly voffs to the |
| (U) (U) (U) | B. Accomplishments/Planned Program (MAJOR THRUST: Develop advanced flig systems for both manned and unmanned ai reducing the size, weight, and cost of contr In FY 2003: Developed and assessed adva operation for manned and unmanned system verification techniques for complex, adaptit technologies for lightweight, long-enduran an integrated prognostic health management In FY 2004: Develop and assess advanced and unmanned systems at reduced size, we verification techniques for complex, adaptit unmanned systems situational awareness in In FY 2005: Continue to develop and asses manned and unmanned systems at reduced affordable validation and verification of co analyses and technologies that enable analy applications in legacy and future air vehicle | ght control syste rcraft. In additi rol and prognost unced control me ms at reduced si ive, and autonor ce air vehicle ap nt system. I control mechan right, and cost. ive, and autonor n airspace opera ss advanced con size, weight, ar omplex, adaptive ytical safety of f | on to increased ic systems. echanization te ize, weight, and nous control so pplications. De nization to prov Continue to de nous control so tions. htrol mechaniz d cost. Develo e, and autonom | d reliability, eff echnologies to p d cost. Demons oftware. Assess eveloped real-ti vide highly reli- velop demonstr oftware. Define ation to provide op and assess to oous control sof ion of advanced | Forts will also for provide highly r strated validations sed micro-effect able operations rations of validate e sensing require highly reliable pols and process frware. Develop d complex contra | ocus on eliable on and ctor ensation using for manned ation and rements for e operations for ses for the p design rol systems for | | <u>7 2003</u> 2.852 | <u>FY 2004</u> 5.718 | <u>FY 2005</u> 7.177 |
| | techniques for unmanned system situationa | | | | | | | | Exhibit D. 2c. // | |
| P10 | ject 2403 | | K-15 | nopping List - Ite | m No. 5-5 of 5-12 | | | | Exhibit R-2a (I | F = 0002201F) |

| BUDGET ACTIVITY PPCNUMBER AND TTLE 022 Applied Research D0622017 F Aerospace Vehicle Technologies PPCNUMBER AND TTLE 000000000000000000000000000000000000 | | Exhibit R-2a, RDT&E Project | Justification | DA | February | 2004 |
|--|-----|---|---|------------|-----------------|---------------|
| development and evaluation of novel flight control effectors for distributed actuation and morphing aerospace vehicles. (U) (U) MAIOR THRUST: Develop flight control systems that will permit safe interoperability between manned aircraft and a forcaft. Concepts will also provide mission responsiveness and adaptability for improved operational effectiveness of manned and unmanned systems. 7.550 4.575 3.679 (U) In FY 2003: Developed and assessed novel control automation techniques and algorithms to enable the safe and interoperable application of unmanned vehicle systems. Conducted feasibility assessments of automated aerial refueling system concept. Developed reliability and performance analyses of self-organizing, distributed control of multi-unmanned vehicle systems. Investigate feasibility of biology inspired control exclinques to simplify unmanned systems automomy implementations. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle systems. 10 (U) In FY 2005: Continue efforts to develop and assess novel control automation techniques sind algorithms to enable safe and interoperable applications of unmanned vehicle systems. Continue development of intelligent situational awareness algorithms to implement autonomous airspace operations control for unmanned vehicle systems. 10 (U) In FY 2005: Continue efforts to develop and methods for capitalizing on simulation-based research and development of incertifications of unmanned vehicle systems. Continue development of incertifications (David) for capitalizing an simulation automation scontrol for unmanned vehicle systems. 5.208 4.003 | | | 0602201F Aerospace Vehicle | 2403 Fligh | | Pilot-Vehicle |
| (U) MAJOR THRUST: Develop flight control systems that will permit safe interoperability between manned aircraft and unmanned systems. Concepts will also provide mission responsiveness and adaptability for inproved operational effectiveness of manned and unmanned systems. 7.550 4.575 3.679 (U) In FY 2003: Developed and assessed novel control automation techniques and algorithms to enable the safe and interoperable application of unmanned vehicle systems. Conducted feasibility assessments of automated aerial refueling system concept. Developed reliability and performance analyses of self-organizing, distributed control of multi-unmanned vehicle systems. Investigate feasibility of biology inspired control techniques to simplify unmanned systems autonomy implementations. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle systems. 8.600 (U) In FY 2004: Continue to develop and assess novel control automation techniques and algorithms to enable safe and interoperable applications of unmanned vehicle systems. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle systems. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle hight formations. Continue development of intelligent situational awareness algorithms to implement autonomous airspace operations control for unmanned vehicle systems. 5.208 4.003 5.787 (U) In PY 2003: Assessed the value of air wehicle topics to future aerospace systems through the development of future aircraft. 5.208 4.003 5.787 | | development and evaluation of novel flight control effectors for distributed actu | • • | | | |
| ummanned aircraft. Concepts will also provide mission responsiveness and adaptability for improved operational effectiveness of manned and ummanned systems. (U) (U) In FY 2004: Continue to and assesses novel control automation techniques and algorithms to enable the safe and interoperable application of ummanned vehicle systems. Conducted feasibility assessments of automated aerial refueling system concept. Developed reliability and performance analyses of self-organizing, distributed control of multi-ummanned vehicle packages. Investigate feasibility of biology inspired control techniques to simplify unmanned systems autonomy implementations. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-ummanned vehicle packages. Develop intelligent situational awareness algorithms to implement autonomous inspace operations control for ummanned vehicle systems. (U) In FY 2005: Continue to florts to develop and assess novel control automation techniques and algorithms to implement autonomous inspace operations control for ummanned vehicle systems. (U) In FY 2005: Continue coftors to develop and assess novel control automation techniques and algorithms to implement autonomous airspace operations. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-ummanned vehicle fight formations. Continue development of intelligent situational awareness algorithms to implement autonomous airspace operations control for unmanned vehicle systems. (U) MAJOR THRUST: Develop tools and methods for capitalizing on simulation-based research and development of include and ummanned with of three apoblity to virtual simulations for unmanned air vehicles systems strough the development and utifization of | (U) | | | | | |
| interoperable application of unmanned vehicle systems. Conducted feasibility assessments of automated aerial refueling system concept. Developed reliability and performance analyses of self-organizing, distributed control of multi-unmanned vehicle packages. (U) In FY 2004: Continue to develop and assess novel control automation techniques and algorithms to enable safe and interoperable application of unmanned vehicle systems. Investigate feasibility of biology inspired control techniques to simplify unmanned vehicle systems. Investigate feasibility of biology inspired control techniques to simplify unmanned vehicle systems. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle packages. Develop intelligent situational awareness algorithms to implement autonomous airspace operations control of unmanned vehicle systems. (U) In FY 2005: Continue efforts to develop and assess novel control automation techniques and algorithms to enable safe and interoperable applications of unmanned vehicle flight formations. Continue development of intelligent situational awareness algorithms to implement autonomous airspace operations control for unmanned vehicle systems. (U) (U) MAJOR THRUST: Develop tools and methods for capitalizing on simulation-based research and development of future aircraft. (U) In FY 2003: Assessed the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems, and processes for simulation-based research and development. Continued development of virtual simulations for unmanned air vehicle sued in validating autonomous control algorithms for mixed manned air vehicle operations. Continue to enhance simulation and analysis capabilities though incorporation of cost models to determine the affordability of new technologies. Continue development of the capability to virtually simulate future strike aircraft. Develop capability to virtually simulate space access operability | (U) | unmanned aircraft. Concepts will also provide mission responsiveness and ada | | 7.550 | 4.575 | 3.679 |
| (U) In FY 2004: Continue to develop and assess novel control automation techniques and algorithms to enable safe and interoperable application of unmanned vehicle systems. Investigate feasibility of biology inspired control techniques to simplement autonomy implementations. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle systems. (U) In FY 2005: Continue efforts to develop and assess novel control automation techniques and algorithms to enable safe and interoperable applications of unmanned vehicle systems. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Continue development of intelligent situational awareness algorithms to implement autonomous airspace operations control for unmanned vehicle systems. (U) In FY 2003: Assessed the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems, and processes for simulation-based research and development and utilization of cost models to determine the affordability of new technologies. Continue development of the capabilities though incorporation of cost models to determine the affordability of new technologies. Continue development of the capabilities though incorporation of cost models to determine the affordability of virtually simulate space access operability. (U) In FY 2004: Assess the value of air vehicle technologies to future aerospace systems through the development of the capabilities though incorporation of cost models to determine the affordability of virtually simulate space access operability. (U) In FY 2004: Assess the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems and processes for simulation-based research and development of the capabilities though incorporation of cost models to determine | (U) | In FY 2003: Developed and assessed novel control automation techniques and interoperable application of unmanned vehicle systems. Conducted feasibility refueling system concept. Developed reliability and performance analyses of se | assessments of automated aerial | | | |
| (U) In FY 2005: Continue efforts to develop and assess novel control automation techniques and algorithms to enable safe and interoperable applications of unmanned vehicle systems. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Continue development of intelligent situational awareness algorithms to implement autonomous airspace operations control for unmanned vehicle systems. (U) (U) MAJOR THRUST: Develop tools and methods for capitalizing on simulation-based research and development of 5.208 4.003 5.787 future aircraft. (U) In FY 2003: Assessed the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems, and processes for simulation-based research and development. Continued development of the capability to virtually simulate future strike aircraft. Develop capability to virtually simulate future strike aircraft. Develop capability to virtually simulate future strike aircraft. Develop capability to virtually simulate space access operability. (U) In FY 2004: Assess the value of air vehicle technologies to future aerospace systems through the development of the capability to virtually simulate future strike aircraft. Develop capability to virtually simulate space access operations. Continued to enhance simulation and analysis capabilities (U) In FY 2004: Assess the value of air vehicle technologies to future aerospace systems through the development and tuilization of in-house tools, systems and processes for simulation-based research and development and tuilization of in-house tools, systems and processes for simulation-based research and development and tuilization and processes for simulation-based research and development and tuilization of in-house tools, systems and processes for simulation-based research and development. Conduct simulation and project 2403 R-1 Sho | (U) | In FY 2004: Continue to develop and assess novel control automation technique interoperable application of unmanned vehicle systems. Investigate feasibility to simplify unmanned systems autonomy implementations. Continue to enhance of self-organizing, distributed control of multi-unmanned vehicle packages. Determined vehicle packages. | of biology inspired control techniques ce reliability and performance analysis evelop intelligent situational awareness | | | |
| (U) MAJOR THRUST: Develop tools and methods for capitalizing on simulation-based research and development of future aircraft. (U) In FY 2003: Assessed the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems, and processes for simulation-based research and development. Continued development of virtual simulations for unmanned air vehicles used in validating autonomous control algorithms for mixed manned and unmanned air vehicle operations. Continued to enhance simulation and analysis capabilities though incorporation of cost models to determine the affordability of new technologies. Continued development of the capability to virtually simulate future strike aircraft. Develop capability to virtually simulate space access operability. (U) In FY 2004: Assess the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems and processes for simulation-based research and development. Conduct simulation assessments of advanced unmanned aerospace vehicles concepts. Continue to enhance simulation and Project 2403 Project 2403 | (U) | In FY 2005: Continue efforts to develop and assess novel control automation to safe and interoperable applications of unmanned vehicle systems. Continue to analysis of self-organizing, distributed control of multi-unmanned vehicle fligh of intelligent situational awareness algorithms to implement autonomous airspa | echniques and algorithms to enable enhance reliability and performance t formations. Continue development | | | |
| future aircraft. (U) In FY 2003: Assessed the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems, and processes for simulation-based research and development. Continued development of virtual simulations for unmanned air vehicles used in validating autonomous control algorithms for mixed manned and unmanned air vehicle operations. Continued to enhance simulation and analysis capabilities though incorporation of cost models to determine the affordability of new technologies. Continued development of the capability to virtually simulate future strike aircraft. Develop capability to virtually simulate space access operability. (U) In FY 2004: Assess the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems and processes for simulation-based research and development. Conduct simulation assessments of advanced unmanned aerospace vehicles concepts. Continue to enhance simulation and Project 2403 R-1 Shopping List - Item No. 5-6 of 5-12 Exhibit R-2a (PE 0602201F) | (U) | | | | | |
| utilization of in-house tools, systems, and processes for simulation-based research and development. Continued development of virtual simulations for unmanned air vehicles used in validating autonomous control algorithms for mixed manned and unmanned air vehicle operations. Continued to enhance simulation and analysis capabilities though incorporation of cost models to determine the affordability of new technologies. Continued development of the capability to virtually simulate future strike aircraft. Develop capability to virtually simulate space access operability. (U) In FY 2004: Assess the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems and processes for simulation-based research and development. Conduct simulation assessments of advanced unmanned aerospace vehicles concepts. Continue to enhance simulation and Project 2403 R-1 Shopping List - Item No. 5-6 of 5-12 | (U) | | based research and development of | 5.208 | 4.003 | 5.787 |
| (U) In FY 2004: Assess the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems and processes for simulation-based research and development. Conduct simulation assessments of advanced unmanned aerospace vehicles concepts. Continue to enhance simulation and Project 2403 R-1 Shopping List - Item No. 5-6 of 5-12 Exhibit R-2a (PE 0602201F) | (U) | utilization of in-house tools, systems, and processes for simulation-based resear development of virtual simulations for unmanned air vehicles used in validating mixed manned and unmanned air vehicle operations. Continued to enhance sin though incorporation of cost models to determine the affordability of new techr the capability to virtually simulate future strike aircraft. Develop capability to | rch and development. Continued g autonomous control algorithms for nulation and analysis capabilities nologies. Continued development of | | | |
| utilization of in-house tools, systems and processes for simulation-based research and development. Conduct simulation assessments of advanced unmanned aerospace vehicles concepts. Continue to enhance simulation and Project 2403 R-1 Shopping List - Item No. 5-6 of 5-12 Exhibit R-2a (PE 0602201F) | (U) | | stems through the development and | | | |
| Project 2403 R-1 Shopping List - Item No. 5-6 of 5-12 Exhibit R-2a (PE 0602201F) | | utilization of in-house tools, systems and processes for simulation-based research | ch and development. Conduct | | | |
| | | simulation assessments of advanced unmanned aerospace vehicles concepts. Co | ontinue to enhance simulation and | | | |
| | Pro | ject 2403 R-1 Shoppin | | | Exhibit R-2a (F | PE 0602201F) |

| Ex | hibit R-2a, RD | T&E Project Ju | stification | | | | DATE | | | |
|---|--|---|--|-----------------------------------|-----------------------------------|------------------------------|------------------|------------|--|--|
| | | | | | | | February | | | |
| BUDGET ACTIVITY 02 Applied Research | | | - | erospace Veh | icle | | ght Controls and | | | |
| analysis capabilities through incorporation Continue development capability to virtua future intelligence, surveillance, and recon future tankers. | lly simulate future s naissance platforms | trike aircraft. Formu s, future high-speed v | late and simulate ehicles, advanced | concepts for l transports and | | | | | | |
| U) In FY 2005: Refine efforts to assess the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems, and processes for simulation-based research and development. Conduct simulation assessments of advanced manned and unmanned aerospace vehicles concepts. Complete the enhancement of simulation and analysis capabilities through incorporation of cost models to determine the affordability of new technologies. Complete the development of the virtual simulation environment for future strike aircraft. Continue to formulate and simulate concepts for future intelligence, surveillance, and reconnaissance platforms, future high-speed vehicles, advanced transports, and future tankers. | | | | | | | | | | |
| (U) (U) CONGRESSIONAL ADD: Intelligent Flight Control Simulation Research. (U) In FY 2003: Establish a distributed Intelligent Flight Control Simulation Research Laboratory capability between (U) In FY 2004: Continue Congressionally-directed effort for intelligent flight control simulation research laboratory. | | | | | | | | | | |
| (U) In FY 2005: Not Applicable.(U) Total Cost | | | | | | 16.777 | 15.486 | 16.643 | | |
| (U) <u>C. Other Program Funding Summary</u> | (<mark>\$ in Millions</mark>) | | | | | | | | | |
| FY | <u>Actual</u> <u>FY 20</u> | | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 20</u> <u>Estin</u> | | Total Cost | | |
| (U) Related Activities: | <u>Actual</u> <u>Estili</u> | | Estimate | <u>Estimate</u> | Estimate | LSun | | | | |
| (U) PE 0602202F, Human Effectiveness Applied Research. | | | | | | | | | | |
| (U) PE 0602204F, Aerospace Sensors. | | | | | | | | | | |
| (U) PE 0603211F, Aerospace Technology Dev/Demo. | | | | | | | | | | |
| (U) PE 0604105F, Next Generation Bomber. | | | | | | | | | | |
| This project has been(U) coordinated through the Reliance process to harmonize | | | | | | | | | | |
| Project 2403 | | R-1 Shopping Lis | t - Item No. 5-7 of F | -12 | | | Exhibit R-2a | | | |

| Exhibit R-2a, RDT&E | Project Justification | DATE |
|--|---|---|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies | February 2004 PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicle Interface |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | |
| efforts and eliminate duplication. | | |
| (U) D. Acquisition Strategy Not Applicable. | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Project 2403 | R-1 Shopping List - Item No. 5-8 of 5-12 86 | Exhibit R-2a (PE 0602201F) |

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justifi | ication | | | DATE | February | 2004 |
|-----|--|---|---|--|--|--|----------------------------------|--------------------------------------|-------------------------|-------------------------|
| | GET ACTIVITY Applied Research | | | 0 | E NUMBER AND 602201F Aero echnologies | | | PROJECT NUME 2404 Aerome | ER AND TITLE | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| 240 | Aeromechanics and Integration | Actual 32.023 | Estimate 20.146 | Estimate 25.205 | Estimate 30.375 | Estimate 31.979 | Estimate 35.261 | Estimate 35.929 | Complete Continuing | TBD |
| 210 | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Continuing | 100 |
| (U) | A. Mission Description and Budget Iten This project develops aerodynamic config methods for fast and affordable aerodynamic vehicle control integration. Technologies these technology programs include lower supportability, safety, and survivability of | urations of a br nics prediction, developed will vehicle costs (b | and integrates greatly enhance oth production | and demonstration and demonstration and demonstration and the second sec | ttes multidiscipl apability in airc | inary advances raft, missiles, a | s in airframe-p nd high-speed | ropulsion, airfra aerospace vehic | me-weapon, ar | nd air ffs from |
| | B. Accomplishments/Planned Program (MAJOR THRUST: Develop aerodynamic unmanned air vehicles. | | rts centered on | expanding the | design capabili | ties of | | <u>2003</u> 6.725 | <u>FY 2004</u> 3.828 | <u>FY 2005</u> 2.588 |
| (U) | In FY 2003: Developed and assessed aeron future missions to reduce life cycle cost and inlet designs that improve airflow to engine propulsion system performance. Continued surveillance missions. | d decrease hum es while providi | an risk. Contir ing low signatu | nued preliminat | ry development d survivability a | of conformal and improved | | | | |
| (U) | In FY 2004: Develop and assess aeronauti missions to reduce life cycle costs and decr wings for long-duration surveillance missio for increased survivability. Continue to pe concept to perform tactical surveillance. A reduced drag and improve propulsion perfor | rease human rist ons. Complete or rform mission a opply flow contr | k. Complete de development of assessment and | evelopment of f technology to develop low-co | signature composition improve engine ost unmanned a | atible, high lift e nozzle design ir vehicle | | | | |
| (U) | In FY 2005: Continue efforts to develop at vehicles in future missions, including offer Continue to perform mission assessment ar surveillance and weapon delivery. Continu achieve reduced drag and improved propul analysis techniques to support virtual and p delivery and propulsion system performance | nd assess aerona asive missions, t ad develop low- the to apply flow sion system per physical models | to reduce life c cost unmanned control technic formance. Init . Continue to c | ycle costs and o l air vehicle con ques to comple iate research in | decrease human ncept to perform ex air vehicle de nto rapid prototy | risk. n tactical signs to pping and | | | | |
| (U) | centery and propulsion system performance | | un venieres. | | | | | | | |
| Pro | pject 2404 | | R-1 S | hopping List - Ite | m No. 5-9 of 5-12 | | | | Exhibit R-2a (F | PE 0602201F) |

| Exhibit R-2a, RDT& | E Project Justification | DA | February | 2004 |
|--|--|--------|----------------------------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies | | IMBER AND TITLE mechanics and | |
| (U) MAJOR THRUST: Develop aerodynamic prediction efforts cent air vehicles. | ered on expanding the design capabilities of manned | 7.045 | 2.216 | 0.000 |
| (U) In FY 2003: Developed design tools that permit quicker and more enhancements to extend the operational life of the current fleet. Of accelerate the aerodynamic integration of new and existing weap ability. Continued to enhance computer design and analysis code | Continued development of analysis tools to ons with current aircraft to enhance their warfighting | | | |
| (U) In FY 2004: Develop design tools that permit quicker and more a enhancements to extend the operational life of the current fleet. O analysis code that reduces the need for expensive flight-testing, in generation and adoption framework. | affordable certification of aerodynamic Continue enhancement of computer design and | | | |
| (U) In FY 2005: Not Applicable. Changes to this program since the Force priorities. | previous President's Budget are due to higher Air | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop new and improved concepts, design revolutionary capabilities for sustained high-speed flight and acce efforts separated into the following related thrust area to allow for access to space efforts.) | ess to space. Note: In FY 2005, access to space | 16.332 | 0.000 | 8.903 |
| (U) In FY 2003: Developed and assessed aerospace technologies that orbit to permit global reach. Continued development of analytic high-speed vehicles to reduce drag. Developed experimental cap Continued development of complex configurations that mitigate t high-speed aerospace vehicles operate. Continued development of aerospace vehicles flying at high speeds and high temperatures. | methods for modeling the plasma flow field over bability to generate and control plasma flows. the extreme thermal environment under which | | | |
| (U) In FY 2004: Not Applicable. Note: In FY 2004, the funding for emphasis being placed on the National Aerospace Initiative. | this effort was decreased to support increased | | | |
| (U) In FY 2005: Develop and assess aerospace technologies that enal to permit global reach. Continue development of integrated airfra aerospace vehicles. Develop analytic methods for modeling the p drag. Complete development of techniques to carry and deploy w speeds (greater than Mach 2) and high temperatures. | ame-propulsion design concepts for high-speed blasma flow field over high-speed vehicles to reduce | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop new and improved concepts, design revolutionary capabilities for access to space. Note: In FY 2005, described in the above related thrust area were broken out to allow | , the access to space efforts were previously | 0.000 | 0.000 | 7.296 |
| Project 2404 | R-1 Shopping List - Item No. 5-10 of 5-12 | | Exhibit R-2a (F | PE 0602201F) |
| | 88 | | | |

| Exhibit R-2a, RDT&E P | roject Justification | DA | February | 2004 | |
|--|---|-------|-----------------|--------------|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies | | JMBER AND TITLE | TITLE | |
| access to space efforts. | | | | | |
| (U) In FY 2003: Not Applicable. | | | | | |
| (U) In FY 2004: Not Applicable. | | | | | |
| (U) In FY 2005: Develop and assess aerospace technologies that enable h | | | | | |
| space. Continue development of computational, multidisciplinary, exp | • | | | | |
| control the flow fields around advanced concepts for ultra-high speed a | | | | | |
| environments, including staging. Develop techniques to evaluate trans | | | | | |
| configurations to validate aero thermodynamic predictions and analysi | s techniques. | | | | |
| (U)(U) MAJOR THRUST: Develop enabling technologies to allow integration | n of directed anargy weapons into current and | 1.921 | 9.066 | 4.141 | |
| future air vehicle platforms. | in or directed energy weapons into current and | 1.921 | 9.000 | 4.141 | |
| (U) In FY 2003: Developed and evaluated critical aeronautical technologi | as to anable directed energy weapons to be | | | | |
| carried on future air vehicles to improve combat effectiveness. Contin | | | | | |
| enhance energy beam transmission through the complex, turbulent aer | • • | | | | |
| enabling the use of directed energy weapons from high-speed, maneuv | | | | | |
| (U) In FY 2004: Continue to develop and evaluate critical aeronautical ted | - | | | | |
| be carried on future air vehicles to improve combat effectiveness. Cor | | | | | |
| enhance energy beam transmission through the complex, turbulent aer | | | | | |
| enabling the use of directed energy weapons from high-speed, maneuv | | | | | |
| utility of high-energy laser on fighter aircraft. Perform flight test measure | - | | | | |
| encountered when employing a laser weapon on a fighter aircraft. Per | = | | | | |
| technologies leading toward a high-energy laser weapon. | | | | | |
| (U) In FY 2005: Develop and evaluate critical aeronautical technologies to | o enable directed energy weapons to be carried | | | | |
| on future air vehicles, including maneuvering fighter aircraft, to impro | ve combat effectiveness. Complete analysis of | | | | |
| the tactical utility a high-energy laser on fighter aircraft. Continue me | asurements of the actual aero-optics effects | | | | |
| encountered when employing a laser weapon on a fighter aircraft. | | | | | |
| (U) | | | | | |
| (U) MAJOR THRUST: Develop and assess technologies for the next gene | eration of multi-role large aircraft. | 0.000 | 5.036 | 2.277 | |
| (U) In FY 2003: Not Applicable. | | | | | |
| (U) In FY 2004: Develop and assess aeronautical technologies to enable r | | | | | |
| designs for rapid global mobility. Develop technologies to enable mul | | | | | |
| Complete innovative designs for re-fueling and transport aircraft to im | | | | | |
| investigation of an aerodynamic flow field behind re-fueling aircraft to | | | | | |
| (U) In FY 2005: Continue efforts to develop and assess aeronautical techn | | | | | |
| Project 2404 R-1 | Shopping List - Item No. 5-11 of 5-12 89 | | Exhibit R-2a (F | PE 0602201F) | |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|---------------------------------|--|---|-----------------------------|-----------------------------------|--|-----------------------------------|----------------------------|-----------------------------|------------------------------|-------------------|
| | GET ACTIVITY Applied Research | | | | PE NUMBER A 0602201F A Technologie | erospace Veh | nicle | PROJECT NUME 2404 Aerome | BER AND TITLE Chanics and | Integration |
| (U) | transport aircraft designs for rapid g enable multiple roles and missions Total Cost | | - | - | ontinue to develo | p technologies t | 0 | 32.023 | 20.146 | 25.205 |
| (U) (U) (U) (U) (U) | C. Other Program Funding Sum Related Activities: PE 0603211F, Aerospace Technology Dev/Demo. PE 0604105F, Next Generation Bomber. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. | <u>mary (\$ in Milli</u> <u>FY 2003</u> <u>Actual</u> | ons) FY 2004 Estimate | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> Estimate | FY 2009 Estimate | Cost to | <u>Total Cost</u> |
| | | | | | | | | | | |
| Pr | pject 2404 | | F | R-1 Shopping List | - Item No. 5-12 of 5 | 5-12 | | | Exhibit R-2a (F | PE 0602201F) |

PE NUMBER: 0602202F PE TITLE: Human Effectiveness Applied Research

| | Exhit | bit R-2, RDT | ſ&E Budge | t Item Just | ification | | | DATE | February | 2004 |
|---|--|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-------|
| BUDGET ACTIVITY PE NUMBER AND TITLE 02 Applied Research 0602202F Human Effectiveness Applied Research | | | | | | | | | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| | Total Program Element (PE) Cost | 75.229 | 87.143 | 71.483 | 74.724 | 86.961 | 79.517 | 81.008 | 0.000 | 0.000 |
| 1123 | Warfighter Training | 10.640 | 10.537 | 11.116 | 12.262 | 15.921 | 13.974 | 14.335 | 0.000 | 0.000 |
| 1710 | Deployment and Sustainment | 10.744 | 7.615 | 8.870 | 9.008 | 10.692 | 10.098 | 10.350 | 0.000 | 0.000 |
| 7184 | Crew System Interface & Biodynamics | 26.735 | 39.982 | 35.420 | 38.768 | 41.646 | 38.373 | 38.856 | 0.000 | 0.000 |
| 7757 | Bioeffects and Protection | 27.110 | 29.009 | 16.077 | 14.686 | 18.702 | 17.072 | 17.467 | 0.000 | 0.000 |

Note: In FY 2003, the protection program at Brooks City-Base, Texas, moved from Project 7184 to Project 7757 to align resources with the Air Force Research Laboratory organization. In FY 2003, space unique tasks in Project 7184 were transferred to PE 0602500F in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description and Budget Item Justification

This program establishes technical feasibility and develops technology for protecting and enhancing human effectiveness for Air Force weapon systems and for operational readiness. The program addresses warfighter training, deployment and sustainment of forces, crew system interface, biodynamic response, directed energy bioeffects, and crew protection. The Warfighter Training project focuses on the development and evaluation of new methods and technologies to enhance Air Force training and education. The Deployment and Sustainment project develops and evaluates technologies that will increase weapon systems and force supportability. The Crew System Interface and Biodynamics project develops and evaluates technologies that will improve the performance and combat effectiveness of humans. The Bioeffects and Protection project develops technologies to predict and mitigate the biological effects of aerospace stressors and directed energy on personnel and mission performance. Note: In FY 2004, Congress added \$1.5 million for Flexible Display and Integrated Communication Device for the Battlefield Air Operations (BAO), \$1.4 million for Three-Dimensional (3-D) Auditory Display, \$1.8 million for Special Operations Target Acquisition and Control Suite, \$1.8 million for Direct Liquid Ethanol Delivery System (DLEDS) for USAF Special Operations Forces (SOF) Combat Control Team BAO Kit, \$10.2 million for Integrated Medical Information Technology System (IMITS) Initiative, \$1.0 million for Advanced Thermal Protection Systems (ATPS), \$1.0 million for Nanoparticles for the Detection and Neutralization of Bioterrorist Agents, \$1.0 million for Mobile Molecular Test Laboratory, and \$1.4 million for Solid Electrolyte Oxygen Separator.

This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

R-1 Shopping List - Item No. 6-1 of 6-21

| DGET ACTIVITY PE NUMBER AND TITLE Applied Research 0602202F Human Effective) B. Program Change Summary (\$ in Millions)) Previous President's Budget) Current PBR/President's Budget) Total Adjustments) Congressional Program Reductions | ness Applied F FY 2003 76.707 75.229 -1.478 | Research <u>FY 2004</u> 66.795 87.143 20.348 | <u>FY 2005</u> 68.693 71.483 |
|--|---|--|------------------------------------|
| Previous President's Budget Current PBR/President's Budget Total Adjustments | 76.707 75.229 | 66.795 87.143 | 68.693 |
| Previous President's Budget Current PBR/President's Budget Total Adjustments | 76.707 75.229 | 66.795 87.143 | 68.693 |
| Current PBR/President's Budget Total Adjustments | 75.229 | 87.143 | |
|) Total Adjustments | | | 71.483 |
| | -1.478 | 20.348 | |
|) Congressional Program Reductions | | | |
| | | -0.005 | |
| Congressional Rescissions | | -0.747 | |
| Congressional Increases | | 21.100 | |
| Reprogrammings | | | |
| SBIR/STTR Transfer | -1.478 | | |
|) <u>Significant Program Changes:</u> | | | |
| Not Applicable. | | | |

R-1 Shopping List - Item No. 6-2 of 6-21

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justifi | ication | | | DATE | February | 2004 |
|-------------------|--|---|--|--|--|---|--|---|--|------------------------------|
| | GET ACTIVITY Applied Research | | | 0 | e NUMBER AND 602202F Hur Applied Resea | nan Effective | eness | | IBER AND TITLE hter Training | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 112 | | 10.640 | 10.537 | 11.116 | 12.262 | 15.921 | 13.974 | | | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) | A. Mission Description and Budget Item This project develops and evaluates new r technical training; mission rehearsal; train spectrum of new and advanced training ar courseware development tools and techno minimum cost. These technologies and m This project contributes to a more highly to | nethods and tec ing in support on ad education tec logies, assessm nethods will income | of complex dec hnologies to de ent methodologies rease operation | ision-making; i esign and imple gies, and simul al readiness by | information wa ement training, ation technolog providing mor | rfare training; a and to evaluate gies to achieve n | and warfare re training effec maximum lear | adiness training ctiveness. It ev ning effectiven | g. It investigates aluates desktop less for specific | s the tutors, needs at |
| Ш | B. Accomplishments/Planned Program (| \$ in Millions) | | | | | F١ | <u> </u> | <u>FY 2004</u> | FY 2005 |
| (U) (U) (U) | MAJOR THRUST: Research perceptual is Distributed Mission Operations environme aircrew training and mission rehearsal, allo In FY 2003: Assessed technical performan projectors, and collimating display screen t the next generation Distributed Mission Tra In FY 2004: Identify requirements for and technologies. Define the visual requirement characteristics and parameters have signific optimized to minimize artifacts and to max helmet-mounted display technologies for fa aircrew visual-task performance. In FY 2005: Develop and apply techniques Evaluate existing and proposed Helmet-Motivisual simulation and training. Identify spe HMDs for training and recommend feature | ssues involving nts. Research in owing Air Force ace of advanced echnologies. D aining (DMT) s evaluate the can the relevant to p cant perceptual imize image qu ast jet visual sin s and devices to pounted Displays ecifications of th | dentifies the vi warfighters to ultrahigh reso etermined feas imulator. pabilities and p erforming the effects, and de ality. Identify nulation. Quar evaluate proje (HMD) and do ne functional re | sual requirements train as they in lution image gest sibility of these performance of DMT tasks, ide termine how th functional requirements for ector displays as eployable disple equirements for | nts necessary for intend to fight. eneration, ultral technology dev various visual entify which visue visual system uirements for do network time do nd visual system lay technologies r deployable dis | or realistic nigh resolution velopments for system sual system a can be eployable and elays have on m components. s for use in | | 1.556 | 1.553 | 1.646 |
| (U) (U) | MAJOR THRUST: Research new comput training. Technologies include representation behavior of computer-generated forces, thr | ion of the visual | , electronic, ar | nd sensor world | l; the weather; a | and the | | 2.030 | 0.000 | 0.000 |
| Pro | ject 1123 | | R-1 S | hopping List - Ite | m No. 6-3 of 6-21 | | | | Exhibit R-2a (I | PE 0602202F) |

| Exhibit R-2a, RDT&E P | roject Justification | DA | February | 2004 |
|--|---|-------|-----------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research | | JMBER AND TITLE | |
| research completed in FY 2003 enables the research in the next two matching (U) In FY 2003: Improved rate of learning by developing pilot performance engagements for use in mission debrief. Determined feasibility of using manager of all participating entities in distributed combat exercises. A as weather servers for all players in a distributed training exercise. An artifacts from the satellite source data used to build visualization tools (U) In EV 2004. Net Applicable | ce diagnostics for end game tactical ng large constructive wargaming model as a assessed existing high-fidelity weather models alyzed methods for eliminating undesirable | | | |
| (U) In FY 2004: Not Applicable.(U) In FY 2005: Not Applicable. | | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop tools, strategies, and performance support training, rehearsal, and operations for aircrews and command and cont forces and global strike operations with the empirical data and guideline of both air and command and control Distributed Mission Training (DI through the identification of competency-based training methods. Not earlier major thrust enables training and rehearsal tools research in FY | rol forces. Research provides the combat air nes for improving the quality and effectiveness MT) and live flight training environments e: Representation technologies research from 2004. | 5.798 | 7.774 | 4.987 |
| (U) In FY 2003: Completed validation of tools to facilitate continuous lear these tools to skills in domains such as intelligence, surveillance, and r Completed operational validation studies of metrics that identify and p delivered in deployable, desktop training environments located in field competencies underlying air superiority and global attack skills. Deve expeditionary force spin-up training and rehearsal. | reconnaissance, and information operations. prioritize mission essential content that can be a settings. Identified mission essential setting DMT content and scenarios for | | | |
| (U) In FY 2004: Complete specifications of mission essential competencied divisions and teams. Complete preliminary training effectiveness eval an operational mission training center. Develop study plan for dynami command and control, air combat, and coalition entities. | uations with the Air Force Weapons School and | | | |
| (U) In FY 2005: Complete guidelines for applying DMT to the Air Comb and mission objectives based on identified competencies. Complete sp for operators in Air Operations Center specialty teams and unique posi models and representations of select operators for use in simulation-ba of specification tools for coalition training and collaborative mission p | becification of mission essential competencies itions. Develop competency-based behavioral used training systems. Complete development | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Explore performance improvement techniques for operational training in realistic mission training environments. Validate enhance command and control training exercises. Note: Training and | te training principles, guidelines, and criteria to | 1.256 | 1.210 | 4.483 |
| Project 1123 R-1 | 1 Shopping List - Item No. 6-4 of 6-21 | | Exhibit R-2a (F | PE 0602202F) |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 | |
|--|---|--|--|--|---|---|-----------------------------------|---|-----------------------------------|-------------------|--|
| BUDGET ACTIVITY 02 Applied Research | 1 | | | | PE NUMBER A 0602202F H Applied Res | luman Effectiv | veness | PROJECT NUMBER AND TITLE 1123 Warfighter Training | | | |
| thrust enables perf (U) In FY 2003: Valic Determined feasib (U) In FY 2004: Utiliz individual compon (U) In FY 2005: Enha for use in synthetic and sustaining aero (U) Total Cost | ated mission esser ility of using enhan- re quantitative data ent tasks. Devise nce air and space of training environm | ntial competence need performant a collection tech techniques to or operations through nents. Explore | ies for selected ce assessment to iniques to analy vercome trainin igh the develop | Air Operations (cols in command ze the overall fu g process shortf ment of training | l and control train nctional process alls or inefficient principles, guide | ining exercises. , as well as cies. elines, and criter | ia | 10.640 | 10.537 | 11.116 | |
| (U) <u>C. Other Program</u> | | (() • • • • • • • • • • • • • • • • • • • | ` | | | | | 10.040 | 10.557 | 11.110 | |
| (U) Related Activities PE 0602233N, Hu Technology. (U) PE 0602716A, Hu Engineering Techn PE 0602785A, Per (U) Performance and Technologies. PE 0603231F, Cre (U) and Personnel Pro Technology. (U) PE 0604227F, Dis Mission Training This project has be coordinated throug (U) Reliance process t efforts and elimina duplication. | man Systems man Factors hology. sonnel Fraining w Systems tection tributed (DMT). een gh the o harmonize | FY 2003 Actual | FY 2004 Estimate | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> | |
| (U) <u>D. Acquisition S</u> Not Applicable. | rategy | | | | | | | | | | |
| Project 1123 | | | | R-1 Shopping List | - Item No. 6-5 of 6 95 | 6-21 | | | Exhibit R-2a | (PE 0602202F) | |

| | Ex | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|------------|--|--|---|--|--|---|---|--|--|-------------------------|
| | ET ACTIVITY oplied Research | | | Q | PE NUMBER AND 0602202F Hun Applied Resea | nan Effective | ness | PROJECT NUMI | BER AND TITLE | stainment |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 1710 | Deployment and Sustainment | 10.744 | 7.615 | 8.870 | 9.008 | 10.692 | 10.098 | | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | A. Mission Description and Budget Iter This project develops technologies to sup Force (AEF) operations. The research fo airlift requirements, while enhancing dep operations and to improve logistics suppo- impact to DoD personnel from exposure to | port the enhance cuses on technol loyed capabilitie ort for both comb to hazardous che | logies that have es. It investiga pat and peaceti | e the potential tes and evaluat me operations. | to reduce the tir tes technologies It develops to? | ne required for to enhance the kicological tool | units to plan, sustainment o s and technolo | pack up, and de of deployed force gy to minimize | eploy, and to rec ses in contingen the risks and m | luce cy nission |
| (U) N 1 | 3. Accomplishments/Planned Program (MAJOR THRUST: Develop logistics sust arge-scale advanced technology developm systems at reduced logistics support costs. | ainment technol | ••• | - | • | | <u>FY</u> | 7 <u>2003</u> 1.864 | <u>FY 2004</u> 1.183 | <u>FY 2005</u> 1.746 |
| (U) I t | n FY 2003: Developed transformation alg echnical order data. Developed artificial lecision-making in synthetic environments | intelligence soft | | | | | | | | |
| r | in FY 2004: Complete development of transition fragment of transition of the synthetic team members. Develop advance | p software comp ed human-comp | onents to reali- uter interface t | stically model echnology for | human interacti logistics and co | on with ntrol systems. | | | | |
| a c | In FY 2005: Conduct research to establish and interface requirements for logistics rea components to accurately model mixed ini | chback in suppo | ort of continger | ncy operations. | Develop softw | are | | | | |
| (U) | | | | | | | | | | |
| 1 | MAJOR THRUST: Develop logistics read arge-scale advanced technology developm ogistics resources for AEF operations. | - | • • • | • | • | | | 1.770 | 2.592 | 1.896 |
| i v | n FY 2003: Conducted feasibility studies nformation to maintenance and logistics p used. Defined technology requirements ar | ersonnel to inclu | ude both the in | formation pres | ented and the p | latforms to be | | | | |
| | naintenance environment. n FY 2004: Continue to conduct feasibili | ty and usability | studies for the | presentation of | f various types (| of information | | | | |
| | oct 1710 | | | - | em No. 6-6 of 6-21 | | | | Exhibit R-2a (F | PE 0602202F) |

| | Exhibit R-2a, RDT&E Pro | pject Justification | DA | February | 2004 |
|------------|--|--|-------|-----------------|--------------|
| | GET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research | | IMBER AND TITLE | |
| (I) | to maintenance and logistics personnel to include both the information pr Continue work to define the technology requirements and component res automated maintenance environment. Identify advanced simulation requ Force units to select the best options for using limited logistics resources In FY 2005: Examine new techniques to identify both functional and sys | search areas necessary to support a completely irements and technology options for Air in crisis action circumstances. | | | |
| (0) | information presentation techniques for future logistics and maintenance the requirements and component technologies necessary to support a more environment. Design foundational models for advanced simulation capa resources during operations. | software tools. Continue working to define re automated and responsive maintenance | | | |
| (U) (U) | MAJOR THRUST: Develop, demonstrate, and apply predictive assessm risks to warfighters if exposed to operational compounds and materials. decision-making ability to properly balance mission and force protection | This will improve the commanders' | 4.672 | 3.840 | 3.849 |
| (U) | In FY 2003: Established biologically based approach for predicting skin solvents, and other hazardous chemicals used in the DoD. Developed in genomics and proteomics to identify exposure of animals to toxic substant develop human biologically based toxicity models. | irritation from dermal contact with fuels, novative biotechnology techniques employing | | | |
| (U) | In FY 2004: Investigate the use of genomics, proteomics, and metabono chemicals and to measure exposures of warfighters to toxic chemicals be Develop simulation models to predict the effects upon the warfighter in c | fore any adverse health effects occur. | | | |
| (U) | In FY 2005: Develop biotechnology procedures and computer simulatio on the warfighter and improve the protection of Air Force personnel. De the function of a cell-like entity with the potential for improved logic, see Air Force systems. | n models to predict effects of toxic exposure evelop and demonstrate algorithms to describe | | | |
| (U) (U) | MAJOR THRUST: Develop Nuclear Magnetic Resonance (NMR) techr to toxic chemicals before they result in illness or a reduction in mission p protection and the probability of mission success. Note: Broken out from emphasis in this area. | performance, thus greatly improving force | 0.000 | 0.000 | 1.379 |
| (U) | In FY 2003: Not Applicable. | | | | |
| | In FY 2004: Not Applicable. | | | | |
| (U) | In FY 2005: Conduct NMR studies to identify target-organ biomarkers i exposed to hazardous agents. Validate target-organ NMR pattern recogn effects of unknown hazardous agents on Air Force personnel. | | | | |
| Pro | • • | Shopping List - Item No. 6-7 of 6-21 | | Exhibit R-2a (F | PE 0602202F) |
| | | 97 | | | |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | D | ATE | 2004 | |
|--|--|--|--------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|--------------------------------|--|-------------------|--|
| BUDGET ACTIVITY 02 Applied Research | 2 Applied Research 0602202F Human Effectiveness Applied Research | | | | | | | February 2004 CT NUMBER AND TITLE Deployment and Sustainment | | |
| (U) (U) CONGRESSIONAL ADD: Biotech (U) In FY 2003: Performed biotechnolo and affiliated universities within the principles of integrated cellular cont applications. | ogy cellular dyna e facilities of the | amics research t Air Force Rese | hrough a not-for arch Laboratory. | Researched and | d developed | ry | 2.438 | 0.000 | 0.000 | |
| (U) In FY 2004: Not Applicable.(U) In FY 2005: Not Applicable.(U) Total Cost | | | | | | | 10.744 | 7.615 | 8.870 | |
| (U) <u>C. Other Program Funding Summ</u> (U) Related Activities: PE 0602233N, Human Systems Technology. PE 0602716A, Human Factors Engineering Technology. PE 0603231F, Crew Systems (U) and Personnel Protection Technology. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate Level 10 | <u>mary (\$ in Milli FY 2003</u> <u>Actual</u> | <u>ons)</u> <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 200</u> <u>Estima</u> | | <u>Total Cost</u> | |
| duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | | | | | | | |
| Project 1710 | | | R-1 Shopping List | - Item No. 6-8 of 6 | -21 | | | Exhibit R-2a | (PE 0602202F) | |

| | Ext | hibit R-2a, I | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|----------------|--|---|--|--|---|--|--|---|--|---|
| | ET ACTIVITY oplied Research | | | C | PE NUMBER AND 0602202F Hur Applied Resea | nan Effective | eness | PROJECT NUME 7184 Crew S Biodynamics | ystem Interfa | ce & |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 7184 | Crew System Interface & Biodynamics | 26.735 | 39.982 | 35.420 | 38.768 | 41.646 | 38.373 | 38.856 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| - | ization. In FY 2003, space unique tasks in unique activities. A. Mission Description and Budget Iter This project develops the technology requires by defining the physical and cognitive part vibration, maneuvering acceleration, spatic criteria, guidelines, and automated design human-centered information operations, to layout and functional integration, aircrew | n Justification hired to improve rameters, capab ial disorientatio tools for the de eam communic | e human perfor ilities, and lim n, and workloa evelopment of ations, and mo | mance, biodyn its of systems o ad; and optimiz effective crew- deling and sim | amic response, operators; detern ing the human- systems interfac ulation. It cond | and survivabili nining human machine interfa ce. It develops lucts experimen | ty in operation responses to op ace. The project and assesses to assesses to | al environment perational stress ct produces hun echnologies for | s. This is accor es such as noise nan-centered de information dis | nplished e, impact, sign play, |
| (U)] (U)] | B. Accomplishments/Planned Program (MAJOR THRUST: Develop interface tech netrics, and human speech processing and in FY 2003: Evaluated methods for emplo events to adjust automation and decision su | (\$ in Millions) nologies for m control solution bying real-time | ulti-sensory ad ns that promote measurement of | laptive controls e intuitive inter of crew workloa | and displays, p face design. ad as it changes | erformance with mission | | <u>7 2003</u> 3.952 | <u>FY 2004</u> 4.857 | <u>FY 2005</u> 5.110 |
| (U)] | For intelligent, on-line physical accommode equipment to adapt to human variability. Consistent of the technologies for supervision of m for FY 2004: Demonstrate a real-time ability adjust automation during future unmanned multi-sensory display concepts and technologies the impact of near-term decision support requirements of intelligen and speech-based countermeasures for infor- dentification capability. | ation tools to op Completed labo ted an advanced aultiple autonom ty to use on-line combat air veh logy for virtual and far-term au t unmanned air prmation operat | ptimize equipm ratory experim l crew station f nous unmanned e estimates of c icle missions. air command i tonomous vehi vehicles. Perf ions, and explo | nent fit, enablin ents exploring for airborne ear d air vehicles. crew workload Perform labora in airborne early icle capability of form research o ore the concept | g future crew st crew interface of ly warning, and and situation av atory demonstra y warning mission the remote in n speech signal of a robust stres | tations and concepts for l explored wareness to tion of ions, and hterface and processing ssed-speaker | | | | |
| Ì, í | • | i a situational a | | 1 | | 0 0 | | | | |
| Proje | ect 7184 | | R-1 S | Shopping List - Ite | em No. 6-9 of 6-21 | | | | Exhibit R-2a (F | PE 0602202F) |

| Exhibit R-2a, RDT&I | E Project Justification | DA | February | 2004 |
|--|---|-------|----------------------------------|-------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research | | MBER AND TITLE System Interfa | ce & |
| multi-platform unmanned combat air vehicle missions. Continue t multi-sensory controls and displays for intelligent autonomous air control aircraft, and extend their functionality beyond airborne ear simulations to determine strike chain efficiencies achievable from controllers, unmanned vehicles, and special forces on the ground. speech-based countermeasures for information operations and dem (U) | vehicles and for multi-mission command and ly warning missions. Perform laboratory network-centric interfaces that span airborne Continue research on speech signal processing and | | | |
| (U) MAJOR THRUST: Develop cognitive information technology for common understanding at all echelons of information operations a battlespace awareness. | | 3.989 | 3.740 | 2.614 |
| (U) In FY 2003: Compared conceptual design options for a cognitive information operations in the future Air Operations Center (AOC). intelligence in support of the Targets Under Trees program. Resea countermeasures for information operations and commenced a mu stressed-speech identification capability including foreign languag | . Improved the ability to fuse imagery and signals arched speech signal processing and speech-based lti-year program to demonstrate a robust | | | |
| (U) In FY 2004: Perform laboratory and field evaluations of a cognitiv information operations in the future AOC. Commence exploration by analyzing information needs and by developing a combat opera the Targets Under Trees program by evaluating target nomination | n of information, display, and course-of-action aids ations visualization concept. Continue to support | | | |
| (U) In FY 2005: Transition to advanced development a cognitive inter information operations in the future AOC. Continue a multi-year e course-of-action aids by demonstrating a multi-mode information in the future action. | exploration of information, display, and | | | |
| (U) (U) MAJOR THRUST: Develop concepts for integrating human-comp human behavior, and real-time simulations to quantify operational | | 3.208 | 3.497 | 3.851 |
| (U) In FY 2003: Developed simulation software for an integrated, unr operator-vehicle interface concepts for mobility using real-time, of dominance with minimum crew size. Explored control-display tec vehicles, and began to assess human performance requirements and imagery in a single display. Aggregated models of human percept military combat scenarios. | nanned air vehicle crew station. Developed ff-board data to assure tactical information chnology options for unmanned reconnaissance d fusion of on-board and off-board sensor data with | | | |
| (U) In FY 2004: Demonstrate an operator-vehicle interface for mobili- information dominance with minimum crew size. Demonstrate a c channelized attention for single operator control of multiple unmar | control-display interface to reduce task load and | | | |
| Project 7184 | R-1 Shopping List - Item No. 6-10 of 6-21 | | Exhibit R-2a (F | |

| Exhibit R-2a, RDT&E Pro | pject Justification | DA | February | 2004 | | |
|---|---|-------|-----------------|--------------|--|--|
| BUDGET ACTIVITY 02 Applied Research | oplied Research 0602202F Human Effectiveness Applied Research Applied Research nodels of human perception, decision-making, and control, and explore model validation strategies. | | | | | |
| models of human perception, decision-making, and control, and explore a (U) In FY 2005: Begin to research requirements and applications for cognitive enable human supervision and control of swarming or distributed teams of explore a control-display concept that reduces task load and channelized and evaluate its use for secondary missions of air refueling and electronic behavior models to reliably evaluate displays, develop fusion algorithms data with imagery, and simulate the ability of a single operator to perform | ve decision-aiding technologies that will of semi-autonomous vehicles. Continue to attention for unmanned combat air vehicles, c attack. Explore the practicality of human that combine on-board and off-board sensor | | | | | |
| (U) MAJOR THRUST: Develop visual display interface technologies, specific night vision technologies, and large flat-panel displays, and develop an u display optics, vehicle transparencies, and synthetic vision. | | 3.910 | 4.108 | 4.259 | | |
| (U) In FY 2003: Demonstrated the ability to calibrate color displays in the fi operational system displays, and developed an approach to model image disparity and distortion, which negatively affect vision through helmet trafeasibility and technical approach for exploiting color night vision in HM flat-panel displays. | quality. Quantified the effects of binocular ansparencies and windscreens. Determined | | | | | |
| (U) In FY 2004: Continue to quantify the effects of binocular disparity, laser windscreens. Begin to develop target acquisition and location symbology tracker technology requirements for HMDs to replace aircraft head-up dis measures suitable for predicting display requirements under realistic view | y for HMDs. Investigate helmet-mounted splays. Begin to assess visual performance | | | | | |
| (U) In FY 2005: Determine ways to reduce the negative effects of binocular helmet visors. Continue to develop HMD target acquisition and location during targeting. Evaluate design options that permit HMDs to replace le explore HMD benefits in remote presence applications. Continue to asse predicting display requirements under realistic viewing conditions. Begin electronically when using head-mounted solid-state imagers. | disparity, lasers, and distortion through symbology to reduce decision uncertainty egacy head-up displays in aircraft, and ess visual performance measures suitable for | | | | | |
| (U) (U) MAJOR THRUST: Develop advanced audio display technologies, inclu- noise reduction, and related technologies that mitigate effects of noise an environment. | - | 2.968 | 3.583 | 3.418 | | |
| (U) In FY 2003: Demonstrated feasibility of 3-D audio for security forces to threat detection in perimeter defense. Recommended technologies, asses develop a high performance (50 dB) hearing protection system. Integrate visualization of the sound field, usable for environmental analysis to char | sed technology risk, and created plan to ed a dynamic noise model with real-time | | | | | |
| Project 7184 R-1 St | hopping List - Item No. 6-11 of 6-21 101 | | Exhibit R-2a (F | PE 0602202F) | | |

| | Exhibit R-2a, RDT&E Project | Justification | DA | February | 2004 | |
|-----|--|--|---|----------------|--------------|--|
| - | GET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research | PROJECT NUMBER AND TITLE 7184 Crew System Interface & Biodynamics | | | |
| | airfields, and usable for developing in-flight tactics in vectored thrust aircraft to adversaries. | minimize acoustic detection by | | | | |
| (U) | In FY 2004: Continue technology development for acoustic remote threat detect recommend auditory symbology for security forces. Characterize the expected with earplugs for a high performance (50 dB) hearing protection system. Contint that can be integrated with real-time visualization of the sound field, usable for the noise environment around airfields, and usable for developing in-flight taction minimize acoustic detection by adversaries. | acoustic noise reduction achievable nue to develop a dynamic noise model environmental analysis to characterize | | | | |
| | In FY 2005: Complete technology assessment of acoustic remote threat detection the use of acoustic detection capabilities by special tactics forces. Demonstrate noise reduction with 3-D audio communications for a high performance (50 dB) and develop a concept to validate the dynamic noise model in terms of lowering and explore acoustic modeling for environmental analysis. Begin to analyze ho vectored thrust aircraft. Begin to develop virtual audio interface technology usi for use with helmet-mounted displays. | the feasibility of combining active) hearing protection system. Identify the cost of collecting acoustic data, w to minimize acoustic detection of | | | | |
| (U) | | | | | | |
| | MAJOR THRUST: Develop integrated human-centered information operations more intuitive access to information, enhanced decision-making capabilities, an In FY 2003: Refined human perception management tools for potential weapor counter-information operations. Developed concepts of operation for effects-ba next-generation planning and decision aids, and warfighter-tailored information on information operations. | d more effective training procedures. nization in offensive and defensive used planning, demonstrations of | 0.713 | 5.947 | 6.003 | |
| | In FY 2004: Conduct research to develop, distribute, and synchronize knowled, among various team members, multiple support teams, and reachback locations technologies and environments in order to enhance predictive battlespace aware Determine feasibility and technical approach for developing adversary cultural training techniques and tools for information warriors. In FY 2005: Conduct research to develop information operations natural collab | via advanced collaboration eness within information operations. decision models, and development of | | | | |
| | modeling, and predictive battlespace awareness capabilities. Develop proof-of measure, and model key parameters. | - | | | | |
| (U) | | | | | | |
| (U) | MAJOR THRUST: Develop human injury criteria and protective system techno encountered in crash and other hazardous environments. Research will develop population accommodation and safety during aircraft and vehicle operations inc | technologies to ensure full aircrew | 5.146 | 5.527 | 4.243 | |
| Pro | pject 7184 R-1 Shopping | List - Item No. 6-12 of 6-21 | | Exhibit R-2a (| PE 0602202F) | |
| | | 100 | | | | |

| Exhibit R-2a, RDT&E P | roject Justification | DA | February | 2004 | |
|---|---|-------|-----------------|--------------|--|
| BUDGET ACTIVITY 02 Applied Research | Applied Research 0602202F Human Effectiveness Applied Research | | | | |
| escape, extended missions, and parachute opening shock. | | | | | |
| (U) In FY 2003: Revised injury criteria based on data from actual mishaps adaptable restraint system technologies, ensuring safety and expedient Force transportation platforms. Human performance research results fr will improve aircrew performance in the operational environment. Res human information processing models that can be incorporated in war models to accurately reflect the effects of physical stressors on human | accommodation of diverse warfighters in Air rom simulated dynamic flight environments search provided cognitive performance and games and simulation-based acquisition | | | | |
| (U) In FY 2004: Revise injury criteria to account for variations in biodyna Develop initial helmet weight and center of mass limits for symmetric (HMD) systems based on crew performance in operational maneuverin processing in this dynamic environment will be quantified and applied wargaming and simulation-based acquisition models. | mic response based on aircrew size and gender. and asymmetric Helmet-Mounted Display ag environments. Human information | | | | |
| (U) In FY 2005: Investigate and evaluate technologies to ensure full aircree operations including vibration, crashes, emergency escape, extended m to revise injury criteria to account for variations in biodynamic response in size and gender. Investigate seating systems to improve crewmember emergency escape or other mishap. Continue development of helmet v and asymmetric HMD systems to ensure safety during emergency escape | hission, and parachute opening shock. Continue se based on individual crewmember differences er comfort while maintaining safety during weight and center of mass limits for symmetric | | | | |
| (U) | T | | | | |
| (U) MAJOR THRUST: Quantify and model the effects of aerospace stress and safety in dynamic flight environments. Develop design criteria to helmet-mounted systems during maneuvering acceleration. Note: Bro increased emphasis in this area. | ensure effectiveness and safety of | 0.000 | 0.000 | 3.222 | |
| (U) In FY 2003: Not Applicable. | | | | | |
| (U) In FY 2004: Not Applicable. | | | | | |
| (U) In FY 2005: Continue development of helmet-mounted systems design on crew performance in operational maneuvering environments. Refin the dynamic environment and initiate incorporation into wargaming an | ne models for human information processing in | | | | |
| (U) | 1 | | | | |
| (U) MAJOR THRUST: Develop technologies to counter Spatial Disorientar resulting in increased mission effectiveness and decreased loss of lives (U) In FY 2003: Integrated emerging technologies such as three-dimension displays to improve pilots' ability to maintain spatial orientation and to | and aircraft lives due to SD mishaps. nal (3-D) audio and pathway-in-the-sky | 1.872 | 2.280 | 2.700 | |
| disorientation if it should occur. | | | | | |
| Project 7184 R-1 | Shopping List - Item No. 6-13 of 6-21 103 | | Exhibit R-2a (F | PE 0602202F) | |

| | Exhibit R-2a, RDT&E Project J | ustification | DA | February | 2004 |
|------------|--|--|-------|---------------------------------------|--------------|
| | GET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research | | MBER AND TITLE System Interfaction | ce & |
| | In FY 2004: Pathway-in-the-sky symbology will be transitioned from a head-up of trials. Ground-based SD training criteria will be developed to better define training training purposes. Alternative HMD off-boresight flight symbology will be flight stimulation, and intuitive flight displays will be integrated in motion-based flight In FY 2005: Complete flight-testing of Pathway-in-the-sky utilizing a HMD to complete flight-testing of Pathway-in-the-sky utilizing a test. | ng devices that can be procured for t-tested, and 3-D audio, tactile simulator testing. | | | |
| | Display to HMD. Develop a syllabus for SD countermeasure training for the Inte Goggles and specific recommendations for the optimum mix of visual, audio, and disorientation. | grated Panoramic Night Vision | | | |
| | CONGRESSIONAL ADD: Three-Dimensional (3-D) Audio Display Technology In FY 2003: Developed a low-cost PC-based 3-D audio display system for enhan aircraft. Developed spatial audio symbology for increasing the situational awaren Demonstrated benefits of 3-D audio cueing in general aviation flight operations u and tests. | cing the safety of general aviation less of general aviation pilots. | 0.977 | 1.388 | 0.000 |
| | In FY 2004: Conduct flight demonstration of low-cost 3-D audio technology usal navigation, and situational awareness enhancement in general aviation aircraft. D permitting recognition of multiple, simultaneous, spatially localized warning sour Conduct virtual simulations to explore when, where, and how 3-D audio technolo with visual displays in fast jet aircraft. In FY 2005: Not Applicable. | evelop improved audio icons ads in tactical military aircraft. | | | |
| (U) (U) | III F I 2003. Not Applicable. | | | | |
| (U) | CONGRESSIONAL ADD: Flexible Display and Integrated Communication Dev (BAO). | vice for the Battlefield Air Operations | 0.000 | 1.487 | 0.000 |
| (U) | In FY 2003: Not Applicable. | | | | |
| | In FY 2004: Initiate development of flexible display and integrated communication air operations. Formulate and develop a technology concept that extends the capa forces units that operate on the ground in forward areas of battle in their role supp control, and target identification/designation. Analyze and identify critical function series of proof-of-principle experimental systems. Fabricate breadboard component laboratory environment. | abilities of special tactics/special borting close air support, air traffic ons and their rollout priority using a | | | |
| | In FY 2005: Not Applicable. | | | | |
| | CONGRESSIONAL ADD: Special Operations Target Acquisition and Control S In FY 2003: Not Applicable. | uite. | 0.000 | 1.784 | 0.000 |
| Pro | ject 7184 R-1 Shopping Li | st - Item No. 6-14 of 6-21 | | Exhibit R-2a (F | PE 0602202F) |
| | | 104 | | | |

| | Tebruary 2004 NUMBER AND TITLE W System Interface & mics | | | | | | | | |
|--|---|--|--|---|---|---------------------|-----------------------------------|-----------------------------------|-------------------|
| | | | | | | | | | |
| (U) In FY 2004: Apply knowledge m prosecution of time-sensitive fixe awareness. This will include cust Research means to integrate sensor rapidly determine threat level and (U) In FY 2005: Not Applicable. (U) (U) CONGRESSIONAL ADD: Direct (SOF) Combat Control Team Bat (U) In FY 2003: Not Applicable. (U) In FY 2004: Demonstrate the feat battlefield air operations. Include equipment by means of fuel cells technologies to curtail stray electric | d and mobile targe om software to sin or data with intellig priority. et Liquid Ethanol I tlefield Air Operat sibility of a DLED ed are radical exten or other electrical | ts by Special Op nplify manual th gence inputs, cor Delivery System ions (BAO) Kit. S to enhance the sions to battery power storage n | perations Forces areat recognition mmunication lin (DLEDS) for U e effectiveness of life for wearable nechanisms. Ex | while improvin and situation as ks, and compute SAF Special Op of SOF combat c e computers and plore lightweigh | g situational sessment. er equipment to berations Forces ontrol teams in peripheral t and durable | 1 | 0.000 | 1.784 | 0.000 |
| custom design options for wearab(U) In FY 2005: Not Applicable.(U) Total Cost | - | | - | , | | | 26.735 | 39.982 | 35.420 |
| (U) <u>C. Other Program Funding Sur</u> | <u>mmary (\$ in Milli</u> | <u>ons)</u> | | | | | | | |
| (U) Related Activities: PE 0602201F, Aerospace Flight Dynamics. PE 0602204F, Aerospace Sensors. PE 0602500F, (U) Multi-disciplinary Space Technology. (U) PE 0602702F, Command, Control, and Communications. (U) PE 0603205F, Flight Vehicle Technology. (U) PE 0603231E, Crew Systems | FY 2003 Actual | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | FY 2008 Estimate | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| (U) PE 0603231F, Crew Systems | | | | Home No. 0.45 | 0.04 | | | | |
| Project 7184 | | F | R-1 Shopping List | - Item No. 6-15 of 105 | 6-21 | | | Exhibit R-2a | (PE 0602202F) |

| Exhibit R-2a, RDT&E F | DATE February 2004 | | | |
|---|---|--|--------------------------|--|
| BUDGET ACTIVITY D2 Applied Research | | | | |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> and Personnel Protection Technology. PE 0603245F, Flight Vehicle Technology Integration. PE 0604706F, Life Support Systems. This project has been coordinated through the U) Reliance process to harmonize efforts and eliminate duplication. U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | |
| Project 7184 R- | 1 Shopping List - Item No. 6-16 of 6-21 | | Exhibit R-2a (PE 0602202 | |

| Exhibit R-2a, RDT&E Project Justification Febr | | | | | | | | | | |
|--|---|---|------------------------------------|--|------------------------------------|------------------------------------|--|------------------------------------|---------------|--|
| BUDGET ACTIVITY 02 Applied Research | | | 0 | E NUMBER AND 602202F Hum Applied Resea | nan Effective | | PROJECT NUMBER AND TITLE 7757 Bioeffects and Protection | | | |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | 0.000 | |
| 7757 Bioeffects and Protection | 27.110 | 29.009 | 16.077 | 14.686 | 18.702 | 17.072 | 17.467 | 0.000 | 0.000 | |
| Quantity of RDT&E Articles Note: In FY 2003, the protection program at Brow | 0 | 0 | 0 | 0 | 0 | 0 | 0 | h T shows | 4 a | |
| (U) <u>A. Mission Description and Budget Item</u> | - | , rexas, moved | i itolii rioject / | 184 10 110ject | | esources with | me An Force R | | lory | |
| This project predicts and mitigates the effect altitude, and high, rapid-onset gravitational ameliorate/counter/exploit the biological eff countermeasures, and aircrew protection. The military operations other than war, and peace | forces. The p fects of aerosp The project als | roject enables bace stressors in o assesses the b | the safe operation | ional use of Air ed energy. It ac | Force aerospae Idresses areas s | ce systems thro such as safety, | ough technolog risk assessmen | y developments t, mission planr | that ning, | |
| military operations other than war, and peacekeeping applications. (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> (U) MAJOR THRUST: Conduct laser optical bioeffects laboratory experiments and field research, enabling exploitation of laser technology while providing countermeasures for optical hazards/threats with and without laser eye protection. (U) In FY 2003: Established feasibility of building a device to allow the evaluation of human vision impacts of multi-wavelength lasers. Completed study on the safety and effectiveness of emerging compact, ultrashort pulse laser technology for information warfare and perception management applications. (U) In FY 2004: Begin developing technologies to evaluate human vision impacts of multi-wavelength lasers. Continue to investigate the safety and effectiveness of multi-short pulse laser technologies for both anti-materiel and non-lethal weapons applications. (U) In FY 2004: Begin developing technologies to evaluate human vision impacts of conducting threshold damage studies to reduce reliance on in vivo experimentation. Develope new methods of conducting threshold damage studies to reduce reliance on in vivo experimentation. Develop bioeffects-based safety criteria for test, deployment, and use of high-energy laser systems. (U) In FY 2005: Continue developing technologies to evaluate human vision impacts of multi-wavelength lasers. Begin developing technologies to evaluate human vision impacts of multi-wavelength lasers. Begin developing technologies to evaluate human vision impacts of multi-wavelength lasers. Begin developing technologies to evaluate human vision impacts of multi-wavelength lasers. Begin developing technologies to evaluate human vision impacts of multi-wavelength lasers. Begin developing technologies to evaluate human vision impacts of multi-wavelength lasers. Begin developing technologies to evaluate human vision impacts of multi-wavelength lasers. Begin developing technologies t | | | | | | | | | | |
| to investigate the safety and effectiveness of anti-material and non-lethal weapons applica studies to reduce reliance on in vivo experim deployment, and use of high-energy laser sy (U) Project 7757 | ations. Contin nentation. Cor | ue to explore n ntinue to develo | new methods of op bioeffects-ba | conducting thr | eshold damage eria for test, | | | Exhibit R-2a (f | PE 0602202F) | |

| Exhibit R-2a, RDT&E P | roject Justification | DA | February | 2004 |
|--|--|-------|--|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research | | JMBER AND TITLE ffects and Protection | |
| (U) MAJOR THRUST: Conduct radio frequency bioeffects laboratory exp | periments to enable safe exploitation of directed | 5.895 | 4.599 | 4.711 |
| energy. (U) In FY 2003: Asessed the biological effects of high power microwave a cellular effects of radio frequency energy. Completed the updated labor (RFR) dosimetry tools for assessment of RFR exposure dose assessme occupational health personnel. Developed radio frequency and optical the proliferation of biological weapons of mass destruction. | pratory and field Radio Frequency Radiation nts by bioenvironmental engineering and | | | |
| (U) In FY 2004: Extend radio frequency dosimetry model to millimeter ra and ultra-wideband microwaves on neural processing and performance recording device. Enhance and apply laboratory techniques and model effectiveness of directed energy for non-lethal applications. | e. Complete evaluation of RFR personal | | | |
| (U) In FY 2005: Enhance and apply laboratory techniques and models for performance impact of exposure to high peak power and ultra-widebar anti-electronic and advanced radar applications. Use bioassessment technon-thermal effects of RFR. Integrate energy-deposition model with e dosimetry tools to assess human hazards to microwave exposure. Con scientifically based effectiveness, hazard, and safety criteria for millim | nd microwaves being developed for chniques to reveal possible low-level and energy-distribution model for advanced tinue to conduct research to support | | | |
| (U) (U) MAJOR THRUST: Develop safety design criteria for portable active of | | 1.155 | 0.000 | 0.000 |
| Expeditionary Force/Agile Combat Support initiative, enabling safe ex(U) In FY 2003: Completed laboratory assessment of portable active denia psychosocial effects of non-lethal applications while attending to the n | ploitation of directed energy weapons. al technology. Assessed cognitive and eeds of the intelligence community. | | | |
| (U) In FY 2004: Not Applicable. Note: Technology transitioned to the A Concept Demonstration in FY 2004 and out. | ctive Denial System Advanced Technology | | | |
| (U) In FY 2005: Not Applicable.(U) | | | | |
| (U) MAJOR THRUST: Develop biotechnologies for Air Force counterprotection, detection, neutralization, and assessment of biologic This major thrust grew out of the radio frequency bioeffects major thrust | al warfare agents for munitions options. Note: | 0.000 | 1.840 | 2.913 |
| (U) In FY 2003: Not Applicable.(U) In FY 2004: Continue feasibility study, including scalability, of biology | gical self-tracking and tracing simulants. Begin | | | |
| design of specific category simulants (i.e., bacterial, viral, and toxin), I (U) In FY 2005: Conduct feasibility studies investigating biological count Continue design of specific category simulants and development of inr | aboratory tests, and scale-up process. erproliferation simulants for munitions options. | | | |
| Project 7757 R-1 | Shopping List - Item No. 6-18 of 6-21 | | Exhibit R-2a (F | PE 0602202F) |

| Exhibit R-2a, RDT&E Project | Justification | DA | February | 2004 |
|--|---|-------|-----------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research | | MBER AND TITLE | |
| (U) (U) MAJOR THRUST: Develop technologies to alleviate the effects of warfighter f enhance vigilance, cognitive and physiological performance, and survivability in mission environments for all warfighters. Note: Aircrew protection research br FY 2005 to separate distinct technology areas. | n sustained and continuous (24/7) | 3.471 | 2.728 | 2.314 |
| (U) In FY 2003: Modeled and operationally validated the effects of fatigue on huma effectiveness to increase the accuracy and realism of current human behavior re- simulations, training exercises, and information warfare planning activities. | - | | | |
| (U) In FY 2004: Continue development of model-based quantitative fatigue manage mission planning and performance assessment. Assess chemical contaminant per produced by an onboard oxygen generation system that has a partially deactivate investigating the effects of a break in oxygen prebreathe time on altitude decom- acceleration-induced degradation in pilot performance that can occur prior to real acceleration. | enetration in aircrew breathing gases ed molecular sieve. Continue pression sickness risk. Quantify | | | |
| (U) In FY 2005: Continue development of counter-fatigue strategies to sustain warf missions and continuous operations. Expand development of model-based quar capabilities to include tactics, techniques and procedures to reduce fatigue-induc command and control and information operations tasks. | ighter performance during extended ntitative fatigue management | | | |
| (U) (U) MAJOR THRUST: Develop technologies and procedures to counter physiologi improve pilot performance under high, rapid-onset gravitational forces, and redu oxygen systems. Research will enhance aircrew safety during global attack, glo missions. Note: Breaks out from previous major thrust in FY 2005 to separate or separate or set. | ice deployment footprint and cost of bal mobility, and special operations | 0.000 | 0.000 | 0.737 |
| (U) In FY 2003: Not Applicable. | | | | |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Complete investigation of effects of break in oxygen prebreathe tir risk. Explore emerging technologies and alternative G-protection concepts for t performance, comfort, and operator acceptability of aircrew life support equipm contaminant penetration in aircrew breathing gases produced by onboard oxygen Continue quick-turn scientific consultations to resolve aircrew protection issues | heir potential to improve ent. Continue assessment of chemical n generation system technologies. | | | |
| (U)(U) CONGRESSIONAL ADD: Rapid Detection of Biological Weapons of Mass D | estruction | 4.195 | 0.000 | 0.000 |
| (U) In FY 2003: Designed and developed improved probe kits to rapidly detect and biological warfare agents. | | 7.175 | 0.000 | 0.000 |
| (U) In FY 2004: Not Applicable. | | | | |
| Project 7757 R-1 Shopping | List - Item No. 6-19 of 6-21 109 | | Exhibit R-2a (F | ~E U6UZ2U2F) |

| Exhibit R-2a, RDT&E P | DA | DATE February 2004 | | | | |
|---|---|-----------------------|---|--------------|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research | | ECT NUMBER AND TITLE Bioeffects and Protection | | | |
| (U) In FY 2005: Not Applicable. | | | | | | |
| (U) (U) CONGRESSIONAL ADD: Solid Electrolyte Oxygen Separator. (U) In FY 2003: Developed solid electrolyte oxygen separation technologi generating systems. Technologies will improve the reliability of oxyge chemical and biological agents, and reduce the deployment footprint as infrastructure. Advanced state-of-the-art capabilities in oxygen genera of the ion-separating ceramic membranes, increasing the liters of oxyg | en generation, ensure an oxygen source free of associated with the current liquid oxygen ation by improving performance characteristics | 6.827 | 1.388 | 0.000 | | |
| devices, and reducing the size, weight, and power requirements of thos (U) In FY 2004: Continue to advance solid electrolyte oxygen separation to oxygen generating systems to provide an oxygen source free of chemic the deployment footprint associated with the current liquid oxygen infr multi-cell electrolyte stacks and investigate their operating current and components into a solid electrolyte oxygen separator technology bread 33 liters per minute. | technologies for aircraft and ground-based cal and biological contaminants while reducing rastructure. Develop next generation (thin film) I pressure limits. Incorporate upgraded | | | | | |
| (U) In FY 2005: Not Applicable.(U) | | | | | | |
| (U) CONGRESSIONAL ADD: Integrated Medical Information Technolog (U) In FY 2003: Not Applicable. (U) In FY 2004: Continue IMITS and expand into Air Force clinics in the (U) In FY 2005: Not Applicable. (U) | | 0.000 | 10.113 | 0.000 | | |
| (U) CONGRESSIONAL ADD: Advanced Thermal Protection Systems (A) (U) In FY 2003: Not Applicable. (U) In FY 2004: Initiate Congressionally-directed effort for ATPS. (U) In FY 2005: Not Applicable. | ATPS). | 0.000 | 0.991 | 0.000 | | |
| (U) (U) CONGRESSIONAL ADD: Nanoparticles for the Detection and Neutr (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop nanoparticles directed to specifically detect and agents. Apply DNA capture element technology to enable nanoparticle biological agents. Link DNA capture elements and nanoparticles and o material even if the original biological agent is destroyed. | facilitate neutralization of potential bioterrorist les to track, recover, identify, and neutralize | 0.000 | 0.991 | 0.000 | | |
| (U) In FY 2005: Not Applicable. | | | | | | |
| Project 7757 R-1 | Shopping List - Item No. 6-20 of 6-21 | | Exhibit R-2a (F | PE 0602202F) | | |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|---|---|---|-----------------------------------|-----------------------------------|-----------------------------------|---------------------|-----------------------------------|----------------------------|-------------------|
| BUDGET ACTIVITY 02 Applied Research | | | | | | | | | |
| (U) (U) CONGRESSIONAL ADD: Mobi (U) In FY 2003: Not Applicable. (U) In FY 2004: Initiate Congressiona (U) In FY 2005: Not Applicable. | | - | lecular Test Lab | poratory. | | | 0.000 | 0.991 | 0.000 |
| (U) Total Cost | | | | | | | 27.110 | 29.009 | 16.077 |
| (U) <u>C. Other Program Funding Sum</u> (U) Related Activities: PE 0602720A, Environmental Quality Technology. PE 0603231F, Crew Systems (U) and Personnel Protection Technology. PE 0604703F, Aeromedical Systems Development. (U) PE 0604706F, Life Support Systems. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. | <u>mary (\$ in Millio</u> <u>FY 2003</u> <u>Actual</u> | <u>Prs</u>) <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | FY 2008 Estimate | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> Complete | <u>Total Cost</u> |
| (U) <u>D. Acquisition Strategy</u> Not Applicable. Project 7757 | | r | 2.1 Shonning List | - Item No. 6-21 of 6 | a 21 | | | Evhibit D 20 | PE 0602202F) |

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PE NUMBER: 0602203F PE TITLE: Aerospace Propulsion

| | Exhit | DATE | DATE February 2004 | | | | | | | |
|------|---|---------|-----------------------|----------|----------|----------|----------|----------|----------|-------|
| | JDGET ACTIVITY PE NUMBER AND TITLE 2 Applied Research 0602203F Aerospace Propulsion | | | | | | | | | |
| | | | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ in Millions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| | Total Program Element (PE) Cost | 135.403 | 126.988 | 92.650 | 109.833 | 119.329 | 116.730 | 117.834 | 0.000 | 0.000 |
| 3012 | Advanced Propulsion Technology | 14.701 | 13.790 | 12.211 | 19.872 | 25.186 | 23.526 | 22.812 | 0.000 | 0.000 |
| 3048 | Fuels and Lubrication | 17.621 | 16.612 | 12.841 | 14.691 | 16.940 | 13.392 | 13.704 | 0.000 | 0.000 |
| 3066 | Turbine Engine Technology | 36.092 | 36.533 | 31.749 | 32.782 | 32.489 | 35.282 | 36.111 | 0.000 | 0.000 |
| 3145 | Aerospace Power Technology | 31.738 | 35.162 | 24.946 | 29.535 | 28.976 | 32.585 | 33.220 | 0.000 | 0.000 |
| 4847 | Rocket Propulsion Technology | 35.251 | 24.891 | 10.903 | 12.953 | 15.738 | 11.945 | 11.987 | 0.000 | 0.000 |

Note: In FY 2003, only the space unique tasks in Projects 3012 and 4847 were transferred to PE 0602500F in conjunction with the Space Commission recommendation to consolidate all space unique activities. In Project 4847, space unique includes all Integrated High Payoff Rocket Propulsion Technology activities except Technology for the Sustainment of Strategic Systems and tactical missiles.

(U) A. Mission Description and Budget Item Justification

This program develops propulsion and power technologies to achieve enabling and revolutionary aerospace technology capabilities. The program has five projects, each focusing on a technology area critical to the Air Force. The Advanced Propulsion Technology develops high-speed airbreathing propulsion engines to include combined cycle, ramjet, and hypersonic scramjet technologies to enable revolutionary propulsion capability for the Air Force. The Fuels and Lubrication project develops new fuels, lubricants, and combustion concepts and technologies for new and existing engines and directly supports the Integrated High Performance Turbine Engine Technology (IHPTET) and the Versatile Affordable Advanced Turbine Engine (VAATE) programs. The Turbine Engine Technology project develops enabling capabilities to enhance performance and affordability of existing weapon systems to include efforts that are part of the IHPTET and VAATE programs. The Aerospace Power project develops efficient energy storage, power generation, and thermal management techniques for ground, air, and space military applications. Finally, the Rocket Propulsion Technology (IHPRPT) and Technology for the Sustainment Systems (TSSS) programs. Note: In FY 2004, Congress added \$3.0 million for Center for Security of Large-Scale Systems; \$2.5 million for High-Power, Advanced Low-Mass Power (HPALM); \$2.2 million for HVEPS for Supersonic Aircraft; \$1.0 million for Cell-Level Battery Control; \$4.3 million for Engineering Tool Improvement Program (ETIP); \$1.0 million for Integrated High Payoff Rocket Propulse for Advanced Vehicle and Propulsion Center; \$1.0 million for Hybrid Plastics; and \$3.0 million for High Power and Hydrogen Generation; \$3.0 million for Pulse Detonation Engine and Laser Induced Thermal Acoustics Instrument; \$1.0 million for Hybrid Plastics; and \$3.0 million for High Power and Laser Induced Thermal Acoustics Instrument; \$1.0 million for Hybrid Plastics; and \$3.0 million for High Powered Electrical Aircraft Capabilities (HiPEAC).

R-1 Shopping List - Item No. 7-2 of 7-25

| Exhibit R-2, RDT&E Bu | DATE February 2004 | | |
|--|--|----------------|----------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602203F Aerospace Propulsion | | |
| U) <u>B. Program Change Summary (\$ in Millions)</u> | | | |
| | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| U) Previous President's Budget | 132.285 | 101.575 | 88.859 |
| U) Current PBR/President's Budget | 135.403 | 126.988 | 92.650 |
| U) Total Adjustments | 3.118 | 25.413 | |
| U) Congressional Program Reductions | | | |
| Congressional Rescissions | | -1.087 | |
| Congressional Increases | | 26.500 | |
| Reprogrammings | 5.500 | | |
| SBIR/STTR Transfer | -2.382 | | |
| U) <u>Significant Program Changes:</u> | | | |
| Not Applicable. | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

R-1 Shopping List - Item No. 7-3 of 7-25

| Ext | nibit R-2a, F | RDT&E Pro | ject Justi | fication | | | I | DATE Februa | ary 2004 |
|--|--|---|---|--|--|-----------------------------------|--------------------------|--|------------------------------|
| BUDGET ACTIVITY 02 Applied Research | | | | PE NUMBER AND 0602203F Aero | | ulsion | | NUMBER AND TI Ivanced Propu Iogy | |
| Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 20 Estima | | |
| 3012 Advanced Propulsion Technology | 14.701 | 13.790 | 12.211 | | 25.186 | 23.526 | | | 000 0.000 |
| Quantity of RDT&E Articles | 0 | 0 | 12.211 | | 0 | 0 | | 0 | 0.000 |
| Note: In FY 2003, space unique tasks in this proactivities. (U) <u>A. Mission Description and Budget Iten</u> This project develops combined/advanced | n Justification | | | - | - | | | | |
| propulsion options for the Air Force. The hydrocarbon-fueled engines capable of op both DoD and NASA. Efforts include mo ground-based demonstrations. | se new engine t berating over a b | technologies water broad range of t | ill enable futu flight Mach n | re high-speed/hy umbers. Techno | personic weap logies develope | ons and aircra ed under this p | ft concept program er | s. The primary f nable capabilities | ocus is on of interest to |
| (U) <u>B. Accomplishments/Planned Program (</u> (U) MAJOR THRUST: Civilian salaries. (U) In FY 2003: This project previously inclu 5027. These funds represent the civilian sa (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. | ded space uniqu | - | | | 2500F, Project | E | <u>7 2003</u> 3.454 | <u>FY 2004</u> 0.000 | <u>FY 2005</u> 0.000 |
| (U) (U) MAJOR THRUST: Develop advanced hydenable the broad application of hypersonics (U) In FY 2003: Fabricated and ground tested tunnel. Showed structural durability in 25 (U) In FY 2004: Continue developing flight w pumps, and engine controllers. Initiate det vehicles. Perform trajectory optimization figenerator/heat exchanger system barbotage throat or air throttle. Verify operation of endettication/characterization coupled with of a ground test engine with a fuel cooled s Note: In FY 2004, several of these activities scramjet demonstration efforts. | s to meet future world's first flig engine tests. D eight engine co ailed analysis fo for flight test. E to fuel injection v ngine control te n fuel control lo structure incorpo | warfighter nee ght weight hydr etermined engi mponents inclu or mating scram Evaluate option with plasma igr chniques, base ogic, to ensure s orating a variab | eds. rocarbon fuele ine operability uding flight we njet flight eng s for scramjet nition, and sila d on rapid sho stable scramje ble geometry i | ed scramjet engin y and performance eight fuel control ines with demon start, including ane injection with ock train t operation. Initianlet for a flight e | ne in a wind ee. I valves, fuel strator gas h a mechanical tate fabrication experiment. | | 11.247 | 13.222 | 7.441 |
| Project 3012 | | R-1 S | | em No. 7-4 of 7-25 | ; | | | Exhibit R | -2a (PE 0602203F) |
| | | | 11 | 5 | | | | | |

| Exhibit R-2a, RDT&I | E Project Justification | DATE February 2004 | | | |
|--|---|-----------------------|---------------------------------------|--------------|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602203F Aerospace Propulsion | | MBER AND TITLE nced Propulsio Y | n | |
| (U) In FY 2005: Continue flight weight engine components developm pumps, and engine controllers. Continue detailed analysis mating Continue performing trajectory optimization for flight test. Continu gas generator/heat exchanger system barbotage fuel injection with mechanical throat or air throttle. Continue verification of operation shock train identification/characterization coupled with fuel control Complete fabrication of a ground test engine for a flight experiment flight experiment. (U) | scramjet flight engines with demonstrator vehicles. nue evaluating options for scramjet start, including plasma ignition, and silane injection with a n of engine control techniques, based on rapid ol logic, to ensure stable scramjet operation. | | | | |
| (U) MAJOR THRUST: Conduct assessments, system design trades, at (CCEs) and advanced cycle airbreathing hypersonic propulsion tec unmanned air and space vehicle concepts. | | 0.000 | 0.568 | 0.256 | |
| (U) In FY 2003: Not Applicable. | | | | | |
| (U) In FY 2004: Initiate system trade studies to determine military pay Initiate defining component and engine performance objectives to demonstrators jointly with NASA and the Defense Advanced Rese | enable development of affordable hypersonic flight | | | | |
| (U) In FY 2005: Continue system trade studies to determine military p Continue defining component and engine performance objectives to flight demonstrators jointly with NASA and the Defense Advanced | bayoff and establish component technology goals. to enable development of affordable hypersonic | | | | |
| (U) | | 0.000 | 0.000 | | |
| (U) MAJOR THRUST: Develop robust hydrocarbon fueled scramjet e into advanced combined cycle engine designs for future missiles a Note: In FY 2005, these activities will be moved from PE 060250 development efforts. | nd for manned and unmanned aerospace vehicles. | 0.000 | 0.000 | 4.514 | |
| (U) In FY 2003: Not Applicable. | | | | | |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Continue development of advanced engine component establish scramjet scaling laws for reusable applications. Develop Mach 4.5 to Mach 3 to provide robust options for combined cycle flame stabilization devices and flight test engine components. | techniques to decrease scramjet take-over from | | | | |
| (U) Total Cost | | 14.701 | 13.790 | 12.211 | |
| Project 3012 | R-1 Shopping List - Item No. 7-5 of 7-25 | | Exhibit R-2a (F | PE 0602203F) | |

| | | Exhibit R- | 2a, RDT&E | Project Jus | | | | DATE | February 2004 |
|-----|---|--------------------------|----------------------------|----------------------------|-----------------------------|----------------------------|----------------------------|---|--------------------------------|
| | GET ACTIVITY Applied Research | | | | PE NUMBER AN 0602203F AG | ND TITLE erospace Pro | pulsion | PROJECT NUME 3012 Advanc Technology | er and title ed Propulsion |
| (U) | C. Other Program Funding Sum | <u>mary (\$ in Milli</u> | <u>ons)</u> | | | | | | |
| | | FY 2003 Actual | <u>FY 2004</u> Estimate | <u>FY 2005</u> Estimate | <u>FY 2006</u> Estimate | <u>FY 2007</u> Estimate | <u>FY 2008</u> Estimate | <u>FY 2009</u> Estimate | Cost to Complete Total Cost |
| (U) | Related Activities: | <u>r tottui</u> | Listimate | Listimate | <u>Estimate</u> | Listimate | Listimate | Listimate | |
| ì í | PE 0601102F, Defense Research | | | | | | | | |
| (U) | Sciences. | | | | | | | | |
| | PE 0602201F, Aerospace Flight | | | | | | | | |
| (U) | Dynamics. | | | | | | | | |
| | PE 0602602F, Conventional | | | | | | | | |
| (U) | Munitions. | | | | | | | | |
| (U) | PE 0602702E, Tactical | | | | | | | | |
| (0) | Technology. | | | | | | | | |
| (U) | PE 0603211F, Aerospace | | | | | | | | |
| (0) | Structures. | | | | | | | | |
| | PE 0603216F, Aerospace | | | | | | | | |
| (U) | Propulsion and Power | | | | | | | | |
| | Technology. | | | | | | | | |
| (U) | PE 0603601F, Conventional | | | | | | | | |
| (0) | Weapons Technology. | | | | | | | | |
| | Program is reported | | | | | | | | |
| | to/coordinated by the Joint | | | | | | | | |
| (U) | Army/Navy/NASA/Air Force | | | | | | | | |
| | (JANNAF) Executive Committee. | | | | | | | | |
| | | | | | | | | | |
| | This project has been coordinated through the | | | | | | | | |
| (ID | Reliance process to harmonize | | | | | | | | |
| | efforts and eliminate | | | | | | | | |
| | duplication. | | | | | | | | |
| (U) | D. Acquisition Strategy | | | | | | | | |
| 1 | Not Applicable. | | | | | | | | |
| 1 | | | | | | | | | |
| Pro | ject 3012 | | | R-1 Shopping List | t - Item No. 7-6 of 7- | -25 | | | Exhibit R-2a (PE 0602203F) |

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justifi | ication | | | DATE | February | 2004 |
|------------|---|--|--|---|---|--|---------------------------------|--------------------------------|---------------------------------|-------------------------|
| | 2 Applied Research 0602203F Aerospace Propulsion 30 | | | | | | | | BER AND TITLE | on |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| 3048 | 3 Fuels and Lubrication | 17.621 | 16.612 | 12.841 | 14.691 | 16.940 | | | | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) | A. Mission Description and Budget Item This project develops improved fuels, lubicycle engines. Systems applications incluinclude fuels and fuels logistics, lubricants Fuels and lubricants for these engines musicost-effective, durable, and reduce pollutations | ricants, mechan ide missiles, air s, bearings, elec st be thermally | craft, sustained | l high-speed ve otor, oil-less en | hicles, and resp gine technology | oonsive space la y, optical diagn | aunch. Analyt ostics, fundam | ical and experimental combusti | mental areas of on, and detonat | emphasis ions. |
| | B. Accomplishments/Planned Program (MAJOR THRUST: Develop low-cost additional additionadditional additional additional additionadditionadditionadditiona | | | | | | <u>FY</u> | <u>7 2003</u> 2.245 | <u>FY 2004</u> 1.835 | <u>FY 2005</u> 1.613 |
| (U) (U) | the flight envelope for manned and unmann In FY 2003: Developed flow-improving ac fuels with JP-8. Developed fuel technologic reduce thermal-oxidative and pyrolytic dep chemical structure-activity relationships for reducing additives to reduce soot emissions. In FY 2004: Continue development of add temperature (high altitude) performance. C 900 degrees Fahrenheit, including thermal existing fuel modeling and simulation capa detailed fuel chemistry. Note: In FY 2004 in this Project. In FY 2005: Optimize additive packages a | dditives for low ies to increase t posits. Complet r fuel additives s and infrared si litive packages t Continue develo stability additiv ibilities by incon 4, the emissions | he temperature ed developmer design and per gnatures from to enable JP-8 ping approache es, fuel deoxys poration of mo and signature | a limit of JP-8 to the of an initial c formance mode propulsion system to achieve jet p es to increase J genation, and in pre realistic add reduction activ | o 900 degrees F computer model eling. Develop tems. propulsion therm P-8 temperature mproved coatin litive performate vities became a | Fahrenheit to I based on ed particulate nally stable low e capability to gs. Enhance nce models and separate effort | 1 | | | |
| | In FY 2005: Optimize additive packages a low temperature performance. Conduct lab Fahrenheit, including thermal stability addi enhancing existing fuel modeling and simu models. Develop engine thermal managem | o-scale tests to i itives, fuel deox ilation capabiliti | ncrease JP-8 te ygenation, and | emperature capa l improved mat | ability to 900 d erials and coati | egrees ngs. Continue | | | | |
| (U) | MAJOR THRUST: Develop advanced add biotechnology, molecular imprinting, and r signature reduction activities became a sep | nano-scale react | ivity enhancen | - | - | - | | 0.000 | 1.026 | 1.000 |
| Proj | ect 3048 | | R-1 S | hopping List - Ite | m No. 7-7 of 7-25 | 5 | | | Exhibit R-2a (| (PE 0602203F) |
| | | | | 118 | 3 | | | | | |

| Exhibit R-2a, RDT& | E Project Justification | DAT | [™] February 2 | 2004 |
|--|--|-------|----------------------------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602203F Aerospace Propulsion | | MBER AND TITLE and Lubricatio | n |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop emission reduction additives. Verify additive tests. Initiated development of improved diagnostics for sub-micro (U) In FY 2005: Continue assessing additive performance in laborator and application of advanced diagnostics for sub-micron particulate (U) | on scale particulate emissions from combustors. y scale combustion tests. Complete development | | | |
| (U) MAJOR THRUST: Study and evaluate low-cost approaches to reduce cost, including field and on-board additive injections and in (U) In FY 2003: Defined improvements in specific additive packages footprint, including on-board fuel evaluation and additization. Confield diagnostic techniques, including on-line quality assessments. (U) In FY 2004: Develop improvements to existing fuel additive pack performance of fuels from alternative (non-petroleum) sources, including technologies for field-fuel quality diagnostics. Investigate the use contamination in fuels. | nprovements to existing fuel additive packages. and fuel dispensing methods to reduce logistics mpleted screening candidate technologies for fuel ages to simplify logistics and reduce cost. Assess cluding Fischer-Tropsch fuels. Test candidate | 1.171 | 1.061 | 1.000 |
| (U) In FY 2005: Develop improvements to existing fuel additive pack performance of fuels from alternative (non-petroleum) sources, inc field fuel quality diagnostics. Further investigate biological contar techniques. | cluding Fischer-Tropsch fuels. Continue testing | | | |
| (U) (U) MAJOR THRUST: Investigate hydrocarbon and other high energy engines for high-speed aerospace vehicles and low-cost access to s (U) In FY 2003: Completed analyses and configuration trade studies to aircraft and military vehicles. Assessed additive approaches to improperties in reduced scale component testing. | pace. o define and evaluate common fuels for future | 1.502 | 0.482 | 0.500 |
| (U) In FY 2004: Initiate development of fuel property and performance alternative hydrocarbon fuels for advanced propulsion. Investigate high heat flux conditions relevant to advanced rockets and combinition. (U) In FY 2005: Develop fuel property and performance database for alternative hydrocarbon fuels for space applications. Test approach flux conditions relevant to advanced rockets and combined cycle explored and combined cycle explored. | e approaches to assess fuel thermal stability under ed cycle engines. industry and Government use in selecting hes to assess fuel thermal stability under high heat | | | |
| (U) (U) MAJOR THRUST: Develop, test, and evaluate revolutionary compulsed detonation, and combined-cycle engines for missiles, mannaspace; perform payoff analyses and configuration trade studies for | ed and unmanned systems, and reuseable access to these systems; and evaluate the combustion and | 3.901 | 3.268 | 3.485 |
| Project 3048 | R-1 Shopping List - Item No. 7-8 of 7-25 | | Exhibit R-2a (F | 'E 0602203F) |

| 022 Applied Research 0602203F Aerospace Propulsion 3048 Fuels and Lubrication emissions characteristics of fuels and fuel additives. In FY 2003: Demonstrated an ultra-compact combustor at design operating conditions for use as an inter-turbine burner. Investigated incorporating pulsed detonation engine (PDE) propulsion technologies into gas turbine engines. Investigated index and combustor designs to reduce emissions from gas turbine engines. Investigated non-traditional thermodynamic cycles for military propulsion systems through simulation/modeling and experimentation. Imvestigate advanced combustor concepts and the inter-turbine burner combustor at conditions that simulate turbine-inlet interactions. Investigate the performance of a rudimentary combined-cycle PDE. Evaluate the technical issues associated with incorporating PDE propulsion technologies into gas turbine engines. Imvestigate interactions is to reduce particulates and emissions from gas turbine engines. (U) In FY 2005: Evaluate the inter-turbine burner combustor at conditions with rotating turbine machinery. Develop and evaluate combined-cycle PDE concepts. Address the operational issues associated with incorporating PDE propulsion technologies into gas turbine engines. Imvestigate interaction to high-speed missiles. Evaluate the operational issues associated with combustor issues associated with combustor issues associated with incorporating PDE propulsion technologies into gas turbine engines. (U) In FY 2005: Evaluate the inter-turbine burner combustor at realistic operating conditions with rotating turbine machinery. Develop and evaluate combined-cycle PDE concepts. Address the operational issues associated with combustor issues associated with combustor signes into gas turbine engines. | Exhibit R-2a, RDT&I | E Project Justification | DA | February | 2004 |
|--|---|--|-------|-----------------|--------------|
| (1) In FY 2003: Demonstrated an ultra-compact combustor at design operating conditions for use as an inter-urbine humer. Investigated inlet and nozade configurations for a PDE. Performed modeling and simulation and initiated experiments to identify fuel additives and combustor designs to reduce emissions from gas turbine engines. Investigated and the non-traditional thermodynamic cycles for military propulsion systems through simulation/modeling and experiments involved the high-speed performance of a rudimentary combined cycle PDE. Evaluate the technical issues associated with incorporating PDE propulsion technologies into gas turbine engines. Forwards and the inter-turbine burner combustor at conditions that simulate turbine-wake and turbine-intel timer combustor at realistic operating conditions with rotating turbine engines. Ferform experiments to validate the high-speed performance of a rudimentary combined cycle PDE. Evaluate the technical issues associated with incorporating PDE propulsion technologies into gas turbine engines. Forwards and the inter-turbine burner combustor at realistic operating conditions with rotating turbine machinery. Develop and evaluate combined-cycle PDE concepts. Address the operational issues associated with combinate-cycle PDE concepts. Address the operational issues associated with combined cycle PDE concepts. Address the operational issues associated with combined treashelp bergonic erritic applications. Note: In FY 2004, the endothermic fuel system site these required for supersonic cruise aircraft. (1) IN Y 2005: Not Applicable: 0.000 0.900 0.500 0.500 (2) IN FY 2005: Volta performation. Information of a systems to minimize regenerative conding the systems. Develop means to improve fuel combustion performance, especially during cold start and cycle transiton. Conduct expe | BUDGET ACTIVITY 02 Applied Research | _ | | | n |
| simulate turbine-wake and turbine-inlet interactions. Investigate the performance of a rudimentary combined-cycle PDE. Evaluate the technical issues associated with incorporating PDE propulsion technologies into gas turbine engines. Perform experiments to validate the high-speed performance of a pure PDE. Complete tests to evaluate promising fuel additives used to reduce particulates and emissions from gas turbine engines. In FY 2005: Evaluate the inter-turbine burner combustor at realistic operating conditions with rotating turbine machinery. Develop and evaluate combined-cycle PDE concepts. Address the operational issues associated with incorporating PDE propulsion technologies into gas turbine engines. Conduct experiments to extend the operability limits of pure PDE for application to high-speed missiles. Evaluate fundamental combustion issues associated with combustors fed by high-temperature fuel systems like those required for supersonic cruise aircraft. MAJOR THRUST: Develop approaches to extend the life of endothermic fuels and fuel system components for sustained supersonic and reusable hypersonic cruise applications. Note: In FY 2004, the endothermic fuel activities in other parts of this Project were consolidated into this activity. In FY 2005: Develop approaches to improve fuel heat sink capability. Develop systems to minimize regenerative cooling heat loads absorbed by endothermic fuel system. Develop means to improve fuel combustion performance, especially during cold start and cycle transition. Improve fuel system modeling and simulation tools to better simulate endothermic fuel behavior. In FY 2005: Continue developing approaches to improve fuel heat sink capability. Test systems to minimize regenerative cooling heat loads absorbed by endothermic fuel systems. Test means to improve fuel combustion performance, especially during cold start and cycle transition. Continue improving fuel system modeling and simulation tools to better s | (U) In FY 2003: Demonstrated an ultra-compact combustor at design burner. Investigated incorporating pulsed detonation engine (PDE Investigated inlet and nozzle configurations for a PDE. Performed to identify fuel additives and combustor designs to reduce emission non-traditional thermodynamic cycles for military propulsion system. | b) propulsion technologies into gas turbine engines. c) modeling and simulation and initiated experiments c) ns from gas turbine engines. Investigated | | | |
| (U) In FY 2005: Evaluate the inter-turbine burner combustor at realistic operating conditions with rotating turbine machinery. Develop and evaluate combined-cycle PDE concepts. Address the operational issues associated with incorporating PDE propulsion technologies into gas turbine engines. Conduct experiments to extend the operability limits of pure PDE for application to high-speed missiles. Evaluate fundamental combustion issues associated with combustors fed by high-temperature fuel systems like those required for supersonic cruise aircraft. (U) (U) MAJOR THRUST: Develop approaches to extend the life of endothermic fuels and fuel system components for sustained supersonic and reusable hypersonic cruise applications. Note: In FY 2004, the endothermic fuel activities in other parts of this Project were consolidated into this activity. (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop approaches to improve fuel heat sink capability. Develop systems to minimize regenerative cooling heat loads absorbed by endothermic fuel system. Develop means to improve fuel combustion performance, especially during cold start and cycle transition. Improve fuel system modeling and simulation tools to better simulate endothermic fuel behavior. (U) In FY 2005: Continue developing approaches to improve fuel heat sink capability. Test systems to minimize regenerative cooling heat loads absorbed by endothermic fuel systems. Test means to improve fuel combustion performance, especially during cold start and cycle transition. Continue improving fuel system modeling and simulation tools to better simulate endothermic fuel behavior. (U) (U) MAJOR THRUST: Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for application to revolutionary combustor and propulsion systems. (U) In FY 2003: Investigated specific pollutant emissions fromation pathways through computational and experimental metho | simulate turbine-wake and turbine-inlet interactions. Investigate the PDE. Evaluate the technical issues associated with incorporating lengines. Perform experiments to validate the high-speed performance. | he performance of a rudimentary combined-cycle PDE propulsion technologies into gas turbine ance of a pure PDE. Complete tests to evaluate | | | |
| (U) MAJOR THRUST: Develop approaches to extend the life of endothermic fuels and fuel system components for 0.000 0.900 0.500 sustained supersonic and reusable hypersonic cruise applications. Note: In FY 2004, the endothermic fuel activities in other parts of this Project were consolidated into this activity. (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop approaches to improve fuel heat sink capability. Develop systems to minimize regenerative cooling heat loads absorbed by endothermic fuel systems. Develop means to improve fuel combustion performance, especially during cold start and cycle transition. Improve fuel heat sink capability. Test systems to minimize regenerative cooling heat loads absorbed by endothermic fuel systems. Test means to improve fuel combustion performance, especially during cold start and cycle transition. Continue improving fuel system modeling and simulation tools to better simulate endothermic fuel behavior. (U) MAJOR THRUST: Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for 0.711 0.833 0.628 application to revolutionary combustor and propulsion systems. (U) In FY 2003: Investigated specific pollutant emissions formation pathways through computational and experimental methods. Evaluated methods to reduce gaseous and particulate pollutant emissions from legacy and future gas turbine | (U) In FY 2005: Evaluate the inter-turbine burner combustor at realistic machinery. Develop and evaluate combined-cycle PDE concepts. incorporating PDE propulsion technologies into gas turbine engine limits of pure PDE for application to high-speed missiles. Evaluate | ic operating conditions with rotating turbine Address the operational issues associated with es. Conduct experiments to extend the operability te fundamental combustion issues associated with | | | |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop approaches to improve fuel heat sink capability. Develop systems to minimize regenerative cooling heat loads absorbed by endothermic fuel systems. Develop means to improve fuel combustion performance, especially during cold start and cycle transition. Improve fuel system modeling and simulation tools to better simulate endothermic fuel behavior. (U) In FY 2005: Continue developing approaches to improve fuel heat sink capability. Test systems to minimize regenerative cooling heat loads absorbed by endothermic fuel systems. Test means to improve fuel combustion performance, especially during cold start and cycle transition. Continue improving fuel system modeling and simulation tools to better simulate endothermic fuel behavior. (U) In FY 2005: Continue developing approaches to improve fuel continue improving fuel system modeling and simulation tools to better simulate endothermic fuel behavior. (U) MAJOR THRUST: Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for 0.711 0.833 0.628 application to revolutionary combustor and propulsion systems. (U) In FY 2003: Investigated specific pollutant emissions formation pathways through computational and experimental methods. Evaluated methods to reduce gaseous and particulate pollutant emissions from legacy and future gas turbine | (U) (U) MAJOR THRUST: Develop approaches to extend the life of endo sustained supersonic and reusable hypersonic cruise applications. | othermic fuels and fuel system components for | 0.000 | 0.900 | 0.500 |
| cooling heat loads absorbed by endothermic fuel systems. Develop means to improve fuel combustion performance, especially during cold start and cycle transition. Improve fuel system modeling and simulation tools to better simulate endothermic fuel behavior. (U) In FY 2005: Continue developing approaches to improve fuel heat sink capability. Test systems to minimize regenerative cooling heat loads absorbed by endothermic fuel systems. Test means to improve fuel combustion performance, especially during cold start and cycle transition. Continue improving fuel system modeling and simulation tools to better simulate endothermic fuel behavior. (U) MAJOR THRUST: Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for 0.711 0.833 0.628 application to revolutionary combustor and propulsion systems. (U) In FY 2003: Investigated specific pollutant emissions formation pathways through computational and experimental methods. Evaluated methods to reduce gaseous and particulate pollutant emissions from legacy and future gas turbine | (U) In FY 2003: Not Applicable. | | | | |
| regenerative cooling heat loads absorbed by endothermic fuel systems. Test means to improve fuel combustion performance, especially during cold start and cycle transition. Continue improving fuel system modeling and simulation tools to better simulate endothermic fuel behavior. (U) (U) MAJOR THRUST: Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for 0.711 0.833 0.628 application to revolutionary combustor and propulsion systems. (U) In FY 2003: Investigated specific pollutant emissions formation pathways through computational and experimental methods to reduce gaseous and particulate pollutant emissions from legacy and future gas turbine | cooling heat loads absorbed by endothermic fuel systems. Develo especially during cold start and cycle transition. Improve fuel syst | p means to improve fuel combustion performance, | | | |
| (U) MAJOR THRUST: Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for application to revolutionary combustor and propulsion systems. (U) In FY 2003: Investigated specific pollutant emissions formation pathways through computational and experimental methods. Evaluated methods to reduce gaseous and particulate pollutant emissions from legacy and future gas turbine | regenerative cooling heat loads absorbed by endothermic fuel syste performance, especially during cold start and cycle transition. Con simulation tools to better simulate endothermic fuel behavior. | ems. Test means to improve fuel combustion | | | |
| application to revolutionary combustor and propulsion systems. (U) In FY 2003: Investigated specific pollutant emissions formation pathways through computational and experimental methods. Evaluated methods to reduce gaseous and particulate pollutant emissions from legacy and future gas turbine | | hanical and laser diagnostic tools and sensors for | 0.711 | 0.922 | 0 679 |
| (U) In FY 2003: Investigated specific pollutant emissions formation pathways through computational and experimental methods. Evaluated methods to reduce gaseous and particulate pollutant emissions from legacy and future gas turbine | | namear, and faser diagnostic tools and sensors for | 0.711 | 0.855 | 0.028 |
| Project 3048 R-1 Shopping List - Item No. 7-9 of 7-25 Exhibit R-2a (PE 0602203F) | (U) In FY 2003: Investigated specific pollutant emissions formation p | | | | |
| | Project 3048 | R-1 Shopping List - Item No. 7-9 of 7-25 | | Exhibit R-2a (F | PE 0602203F) |

| Exhi | bit R-2a, RDT&E Project Justifica | tion | DAT | February 2 | 2004 |
|---|---|--|--------------------------|-----------------|-------------|
| BUDGET ACTIVITY 02 Applied Research | | JMBER AND TITLE 203F Aerospace Propulsion | PROJECT NU 3048 Fuels | n | |
| laser light interaction with matter. (U) In FY 2004: Investigate pollutant emission f Evaluate methods to reduce gaseous and part Continue investigating high intensity laser lig capabilities. Initiate development and demon extension of component life. (U) In FY 2005: Continue developing and testing component life. Develop diagnostic tools to | iculate pollutant emission from legacy and futu the interaction with matter for micromachining distration of sensors for the control of combustor | experimental methods. are gas turbine engines. and diagnostic r performance and ance and extension of les burning | | | |
| diagnostic capabilities.(U)(U) MAJOR THRUST: Develop, test, and conduct | | eliable and affordable | 1.320 | 1.799 | 1.940 |
| (U) In FY 2003: Supported field activities for av and tested advanced bearing and lubrication s performance, affordability, and engine health | | tional units. Developed r improved engine onfiguration trade studies | | | |
| improved engine performance, affordability, configuration trade studies to define, focus, a | s for aviation lubrication technologies and DoD l bearing and lubrication system concepts, com and engine health monitoring. Perform payoff nd evaluate research in lubricants and mechani e engines. Begin transition of optimal ester lub | ponents, and materials for analyses and cal systems for man-rated, | | | |
| improved engine performance, affordability, | bearing and lubrication system concepts, com and engine health monitoring. Initiate testing t ated, expendable, and unmanned air vehicle tur | ponents, and materials for to focus and develop | | | |
| (U) (U) MAJOR THRUST: Develop and test advance engine applications. | | , and large-sized turbine | 2.796 | 2.481 | 2.175 |
| (U) In FY 2003: Developed advanced bearing co Designed, fabricated, and tested electromagn | ncepts for small- and intermediate-sized turbing etic rotor support and power generation concep reloped and initiated testing of air and foil bear | ots, components, and | | | |
| Project 3048 | R-1 Shopping List - Item No | • • | | Exhibit R-2a (P | E 0602203F) |

| Exhibit R-2a, RDT&E Pi | oject Justification | DA | February | 2004 | | | | |
|--|---|-------|-----------------|--------------|--|--|--|--|
| BUDGET ACTIVITY 02 Applied Research | | | | | | | | |
| and intermediate-sized turbine engine applications. Initiated developm advance design, shorten development time, and reduce testing requirem support and power generation systems. Commenced advanced rotor su engine. Matured hybrid (metal/ceramic) bearing technologies to Joint S (U) In FY 2004: Continue developing advanced bearing concepts for small- | nents for mechanical and electromagnetic rotor pport and power generation studies for turbine trike Fighter (JSF) F136 engine. | | | | | | | |
| applications. Perform full-scale rig testing of electromagnetic rotor sup advanced, oil-less engines. Begin study and testing of air/foil bearings Continue development and testing of affordable rotor support technolog turbine engine applications. Continue modeling and simulation capabil time, and reduce testing requirements for mechanical and electromagne systems. Start modeling rotordynamics of air/foil bearing supported en and power generation studies and start testing for turbine and combined | for propulsion turbine engine application. gy for small, intermediate, and large-sized lities to advance design, shorten development etic rotor support and power generation gine shafts. Conduct advanced rotor support l cycle engines. Continue to mature hybrid | | | | | | | |
| (metal/ceramic) bearing technology that could be applied to JSF F135 et (U) In FY 2005: Continue developing and initiate testing of advanced bear large-sized turbine engine applications. Conduct realistic engine front-support and a power generation system for advanced, oil-less engines. load capacity and rotor size limitations of this technology. Develop and small-, intermediate-, and large-sized turbine engine applications. Enha advance design, shorten development time, and reduce testing requirem support and power generation systems. Conduct modeling of air/foil be Conduct advanced rotor support and power generation studies and start engines. Support rig testing of hybrid bearing designs for F136 engine. | ing concepts for small-, intermediate-, and end simulation testing of electromagnetic rotor Conduct air/foil bearing testing to determine d test affordable rotor support technology for ance modeling and simulation activities to ents for mechanical and electromagnetic rotor earings and iterate results with test activity. testing for turbine and combined cycle | | | | | | | |
| (U) (U) MAJOR THRUST: Develop thermal management concepts and analysy varying speed classes. Note: In FY 2004, these efforts were combined approaches" in this Project. | | 1.057 | 0.000 | 0.000 | | | | |
| (U) In FY 2003: Conducted fuel trade studies to identify fuel options and c applications. Developed diagnostic approaches and sensors for control the flight envelope. Developed of engine fuel system and thermal man Affordable Advanced Turbine Engine program. | of fuel/thermal management systems across | | | | | | | |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. (U) | | | | | | | | |
| (U) CONGRESSIONAL ADD: Pulse Detonation Engine (PDE) including | | 2.918 | 2.927 | 0.000 | | | | |
| Project 3048 R-1 | Shopping List - Item No. 7-11 of 7-25 | | Exhibit R-2a (I | PE 0602203F) | | | | |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DA | February | , 2004 | |
|---|---|---|---|--|--|-----------------------------------|--------------------------|--|--------------------|--|
| BUDGET ACTIVITY 02 Applied Research | | | | | | | | JECT NUMBER AND TITLE 8 Fuels and Lubrication | | |
| efforts in FY 2004. (U) In FY 2003: Established a design of components to include the inlet, in airbreathing PDE for use in subsom of some of the key components and predictive models using experiment to unmanned vehicles and high-specific terms. | take valve, fuel ir ic and supersonic d continued devel ital data. PDE's o | ijector, detonation cunmanned air v opment of Pulse offer potential fo | on initiator, cont vehicles. Perform Detonation Eng | roller, and thrust med ground dem gine (PDE) perfo | t tube for an nonstration testin prmance | g | | | | |
| (U) In FY 2004: Complete the design of controller and thrust tube for an air design validation testing of the key Continue the design of a demonstration (U) In FY 2005: Not Applicable. (U) Total Cost | breathing PDE for components and | or use in subsoni continue develo | c and supersonic opment of engine | c unmanned air v | vehicles. Perform | | 17.621 | 16.612 | 12.841 | |
| (U) <u>C. Other Program Funding Sum</u> | mary (\$ in Milli | ons) | | | | | 17.021 | 10.012 | 12.041 | |
| (U) Related Activities: (U) PE 0601102F, Defense Research Sciences. (U) PE 0602805F, Dual Use Science and Technology. PE 0603216F, Aerospace (U) Propulsion and Power Technology. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) D. Acquisition Strategy Not Applicable. | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 200</u> Estimat | | <u>Total Cos</u> t | |
| Project 3048 | | F | R-1 Shopping List | <u>Item No. 7-12 of 1</u> | 7-25 | | | Exhibit R-2a | (PE 0602203F) | |

| | Exh ACTIVITY lied Research | nibit R-2a, F | RDT&E Pro | ject Justifi | ication | | | DATE | | | |
|--|--|---|---|--|--|--|--|--|---|----------------------|--|
| | | | | - | | | | | February | 2004 | |
| | | | | | E NUMBER AND | | PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology | | | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total | |
| 3066 | Turbine Engine Technology | 36.092 | 36.533 | 31.749 | 32.782 | 32.489 | 35.282 | 36.111 | 0.000 | 0.000 | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| Ti co sy Ti jo | <u>Mission Description and Budget Item</u> his project develops technology to increa onsumption, and cost of ownership. Ana ystems, controls, augmentor and exhaust his project supports the Integrated High I int DoD, NASA, and industry efforts to AATE activity relative to the turbine-bas | tse turbine engination lytical and expension systems, integra Performance Tu focus turbine pu | erimental areas ated power and urbine Engine ropulsion techr | of emphasis and thermal mana rechnology and nology on natio | re fans and com agement systems d Versatile Affo onal needs. The | pressors, high s, engine inlet i ordable Advance FY 2004 prog | temperature contegration, me red Turbine En ram plan reflect | ombustors, turb chanical system gine (VAATE) cts the technolo | ines, internal flo ns, and structura programs, whi gy base support | al design. ch are | |
| VAATE activity relative to the turbine-based combined cycle technology development applicable to sustained high-speed flight and responsive space launch. (U) B. Accomplishments/Planned Program (\$ in Millions) FY 2003 FY 2004 FY 2005 (U) MAJOR THRUST: Develop core turbofan/turbojet engine components (i.e., compressors, combustors, and 24.111 27.937 16.787 high-pressure turbines) for fighters, bombers, sustained supersonic/hypersonic cruise vehicles, and transports. These components, made with advanced materials like Titanium Matrix Composites and gamma titanium aluminides, enable aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost. V In FY 2003: Completed preliminary testing on an advanced high-pressure ratio compressor for reduced fuel burn, and | | | | | | | | | | | |
| res fue tra: exp (U) In red | U) In FY 2003: Completed preliminary testing on an advanced high-pressure ratio compressor for reduced fuel burn, and high reaction blading for reduced maintenance cost. Conducted testing on an active combustion control high response fuel valve reducing acoustically coupled fatigue and enhancing overall combustion efficiency resulting in fuel burn reduction. Modified the spar/shell turbine blade design system using component bench test results and transitioned this technology to engine demonstrator testing. Completed the sub-scale rotational intentional mistuning experiment and initiated the application of methodology to transonic rig hardware. U) In FY 2004: Complete airfoil design for a high-pressure ratio compressor to study unsteady flow interactions for reduced fuel burn, and high reaction blading and engine stall avoidance techniques for reduced maintenance cost. | | | | | | | | | | |
| adv for exp (U) In int ma int | gin full annular aerothermal tests of a tra vanced high-pressure turbine rig hardwar increased performance and durability. I perimental verification on transonic rig h FY 2005: Begin rig testing of a high-pre eractions for reduced fuel burn, and high intenance cost. Continue full annular ae egrated lightweight combustor with a cer advanced combustor configurations. Con | e to evaluate ac Develop advanc ardware. essure ratio com reaction bladin rothermal tests ramic matrix co | lvanced three- ed intentional appressor includ ag and engine s of a trapped vo mposite shell a ion and initiate | dimensional eff mistuning meth ing an assessm itall avoidance prtex combusto and advanced n tests of advance | fects pm blade t hodology and b eent of unsteady techniques for 1 or and begin rig naterial panels 1 ced high-pressu | tip heat transfer egin flow reduced testing of an representative ire turbine rig | | | | | |
| Project | 3066 | | R-1 Sł | hopping List - Iter 124 | m No. 7-13 of 7-2 | 5 | | | Exhibit R-2a (I | PE 0602203F) | |

| Exhibit R-2a, RDT&E I | Exhibit R-2a, RDT&E Project Justification | | | | | | |
|--|--|--|-----------------|--------------|--|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602203F Aerospace Propulsion | PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology | | | | | |
| hardware to evaluate advanced three-dimensional effects on blade tip durability. Enhance advanced intentional mistuning methodology an transonic rig hardware. | - | | | | | | |
| (U) | | | | | | | |
| (U) MAJOR THRUST: Develop turbine engine components (i.e., fans, le nozzles, and integration technologies) for turbofan/turbojet engines for and hypersonic cruise vehicles, and transports. These components en performance, increased durability, reduced fuel consumption, and low | or fighters, bombers, sustained supersonic strike hable aircraft engines to have higher | 7.093 | 8.151 | 10.511 | | | |
| (U) In FY 2003: Conducted testing of a non-linear control system to simulate the component performance trend data necessary for transitioning this program. | | | | | | | |
| (U) In FY 2004: Begin design of an advanced tandem, forward swept far composite reinforced disks to achieve high efficiency and stage loadi three-dimensional computational fluid dynamics (CFD) analysis and turbine rig hardware to assess performance of advanced turbine blade endurance systems including Global Hawk. Initiate testing of advance life models to verify real-time computational capabilities for transition program. Begin analysis and testing of advanced, low-observable comproved design rules and tools to improve augmentor operability and (U) In FY 2005: Begin fabrication of an advanced tandem, forward swept and composite reinforced disks to achieve high efficiency and stage 1 post-test analysis of multi-stage low-pressure rig test data to assess per configurations applicable to high altitude, long endurance systems in advanced control system hardware using component life models to vertansitioning this technology to a demonstrator engine program. Exp low-observable compatible augmentor designs, resulting in improved operability and reduce screech. | ng with reduced weight and cost. Perform detailed design of multi-stage low pressure e configurations applicable to high altitude, long ced control system hardware using component oning this technology to a demonstrator engine mpatible augmentor designs, resulting in d reduce screech. ot fan incorporating hybrid blade construction oading with reduced weight and cost. Perform erformance of advanced turbine blade cluding Global Hawk. Continue testing of erify real-time computational capabilities for and analysis and testing of advanced, | | | | | | |
| (U) (U) MAJOR THRUST: Develop limited life engine components for miss including long-range supersonic and hypersonic vehicles. These com reduced fuel consumption, and increased specific thrust, thereby great missiles and unmanned vehicles. | ponents enable engines with reduced cost, | 3.297 | 0.294 | 3.342 | | | |
| (U) In FY 2003: Completed rig testing of an enhanced fan flow control t shrouded rotor. Designed rub tolerant ceramics for advanced turbine | rotor blades. | | | | | | |
| (U) In FY 2004: Begin the conceptual design and conduct configuration | | | | | | | |
| Project 3066 R- | 1 Shopping List - Item No. 7-14 of 7-25 | | Exhibit R-2a (I | PE 0602203F) | | | |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|------------|---|--|--|---------------------------------------|----------------------------|-----------------------------------|---------------------|-----------------------------------|----------------------------|--------------|
| | DGET ACTIVITY Applied Research | | | | PE NUMBER A 0602203F A | ND TITLE erospace Pro | pulsion | PROJECT NUME 3066 Turbine | | hnology |
| (U) (U) | high-pressure core and engine comp meet the small engine performance In FY 2005: Complete configuration high-pressure core and low-pressure blades to meet the small engine per | and cost reduction on studies and co e component con | on objectives. ntinue conceptu figurations for e | al design of an a expendable engin | dvanced versati | le and affordable | | | | |
| · · · | MAJOR THRUST: Develop comp | | haft/turboprop a | and small turbof | an engines for tr | ainers, rotorcraf | İt, | 1.591 | 0.151 | 1.109 |
| (U) | special operations aircraft, and thea In FY 2003: Conducted durability high-pressure/high moisture conditi demonstrate the feasibility of a very | tests of Ceramic ions to validate c | omposite integr | ity and life mode | els. Performed r | ig tests to | | | | |
| | In FY 2004: Begin conceptual desi high-pressure compressor, combust meet the small engine performance | tor, and high-pres and cost reduction | ssure turbine con on objectives. | nfigurations for t | urboshaft/turbop | prop engines to | | | | |
| (U) | In FY 2005: Enhance conceptual d configurations for turboshaft/turbog | - | | | | | | | | |
| (U) | Total Cost | | | 8 F | | | | 36.092 | 36.533 | 31.749 |
| (U) | C. Other Program Funding Sum | • • | | | | | | | _ | |
| | | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> Estimate | <u>FY 2007</u> <u>Estimate</u> | FY 2008 Estimate | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> Complete | Total Cost |
| (U) (U) | Related Materials: PE 0601102F, Defense Research Sciences. | rotua | Linac | Littinate | Littlinde | Littinace | Estinate | Listimate | Complete | |
| (U) | PE 0602102F, Materials. PE 0603216F, Aerospace | | | | | | | | | |
| (U) | Propulsion and Power Technology. | | | | | | | | | |
| (U) | PE 0602122N, Aircraft Technology. | | | | | | | | | |
| (U) | PE 0603210N, Aircraft Propulsion. | | | | | | | | | |
| (U) | PE 0603003A, Aviation | | | | | | | | | |
| (U) | Advanced Technology. This project has been | | | | | | | | | |
| Pr | oject 3066 | | F | R-1 Shopping List | - Item No. 7-15 of | 7-25 | | | Exhibit R-2a (| PE 0602203F) |

| Exhibit R-2a | , RDT&E Project Justification | DATE February 2004 | | |
|---|--|--|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602203F Aerospace Propulsion | PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology | | |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> coordinated through the Reliance process to harmonize efforts and eliminate duplication. |) | | | |
| (U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | |
| Project 3066 | R-1 Shopping List - Item No. 7-16 of 7-25 | Exhibit R-2a (PE 0602203F) | | |

| | Ext | nibit R-2a, F | DT&E Pro | ject Justif | fication | | | DATE | Echrucry | 2004 |
|--|---|---|--|---|--|--|---|--|--|-------------------------------|
| BUDGET ACTIVITY 02 Applied Res | | | | - F | PE NUMBER AND 0602203F Aer | | | | February BER AND TITLE ace Power To | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| 3145 Aerospa | an Dower Tanhrala av | Actual | Estimate | Estimate | Estimate | Estimate 28.076 | Estimate | Estimate | Complete 0.000 | 0.000 |
| | ce Power Technology v of RDT&E Articles | 31.738 | 35.162 | 24.946 | 1 | 28.976 | 32.585 | 33.220 | 0.000 | 0.000 |
| This projec technologie storage tech technologie | Description and Budget Iter t develops techniques for effic s are developed to increase rel mologies to enable the 10-20 y s to enable all future military on the target indication radar and h | ient power gene iability, maintai year-long term e lirected energy | nability, comm nergy storage g weapon system | nonality, and s goals of Air Fo ns. This projec | supportability of orce unmanned ct supports deve | f aircraft and fli vehicles. Elect elopment of ver | ght line equipn rical power gen y high output p | nent. Research neration and th power systems | is conducted in ermal managen suitable for app | n energy nent lications |
| (U) <u>B. Accompli</u> (U) MAJOR TH component a | ishments/Planned Program (RUST: Develop power genera nd subsystem technologies for sufficiency, reliability, maintai ties. | ation/conditioning manned and ur | manned aircra | ft systems. Th | hese technologie | es improve | | <u>2003</u> 8.380 | <u>FY 2004</u> 11.874 | <u>FY 2005</u> 12.208 |
| (U) In FY 2003: | Tested an advanced-switched nium-ion batteries and fuel cell | | | | | | | | | |
| lithium-base | Continue testing of an advance d solid-state electrolyte battery st class turbine engine high spo | technology. P | | | - | | | | | |
| systems for 1 | Fabricate and test small-scale nanned and unmanned vehicle ed switched reluctance machin | es. Verify dynar | | | | | | | | |
| | RUST: Develop thermal mana chnologies for air and space ap | | storage and p | ower condition | ning component | ts, and | | 4.480 | 2.479 | 2.870 |
| distributed p full-scale lith monitoring a | • | weight and volu pacecraft applic | me of convent ations. Devel | ional approacl oped prelimin | hes. Fabricated ary integrated v | and tested rehicle health | | | | |
| | Continue development of inte | grated vehicle h | | | - | | | | | |
| Project 3145 | | | R-1 Sh | opping List - Ite 128 | m No. 7-17 of 7-2 | 5 | | | Exhibit R-2a (| PE 0602203F) |

| Exhibit R-2a, RDT&E I | Project Justification | DA | DATE February 2004 | | |
|--|--|-------------------------|-----------------------|--------------|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602203F Aerospace Propulsion | PROJECT NU 3145 Aero | | | |
| techniques for silicon carbide power electronics.(U) In FY 2005: Integrate vehicle health monitoring algorithms into pow of a silicon carbide packaging concept for power electronic device detection. | | | | | |
| (U) (U) MAJOR THRUST: Develop cryogenic power generation, high rate b components, and system technologies with low volume displacement of directed energy weapons | | 8.301 | 8.215 | 9.868 | |
| (U) In FY 2003: Completed preliminary fabrication and testing of high-d and switches, for directed energy weapon systems. Tested a thermal Copper Oxide coated wire and coils for cryogenic generator applicati (pulse power) lithium-ion batteries. | management system with Yttrium Barium | | | | |
| (U) In FY 2004: Design and fabricate advanced capacitors for pulsed por testing liquid dielectric high voltage switches. Optimize processing t Copper Oxide high temperature superconducting components. Fabric cells. | echniques for long length Yttrium Barium | | | | |
| (U) In FY 2005: Test advanced pulse power capacitors. Complete testin high temperature Yttrium Barium Copper Oxide superconducting coi applications. Scale-up and begin testing high rate lithium-ion (liquid proof-of-concept superconducting generator. | ls in a rotating test rig for megawatt-class power | | | | |
| (U) | | | | | |
| (U) MAJOR THRUST: Develop high-density electrical power system ar generation aerospace long-range strike vehicle. | d thermal management technologies for a next | 1.826 | 0.000 | 0.000 | |
| (U) In FY 2003: Developed power and thermal requirements for a long-reveapon systems and performed preliminary compact high power commanagement component designs that optimize secondary power system | ditioning, energy storage, and thermal em size, weight, and efficiency. | | | | |
| (U) In FY 2004: Not Applicable. Note: In FY 2004, funding for this eff(U) In FY 2005: Not Applicable.(U) | ort was shifted to higher Air Force priorities. | | | | |
| (U) CONGRESSIONAL ADD: PBO (poly-based: p-phenylene-2, 6-ben Performance Fuel Cells. Note: For developing and certifying this ma | - | 2.430 | 0.000 | 0.000 | |
| (U) In FY 2003: Developed poly-based membrane fuel cells that offer a and more energy efficient fuel cell over existing proton exchange me cell research, designed, and fabricated a preliminary model PBO-base (U) In FY 2004: Not Applicable. | lower cost, lighter weight, higher performance, mbrane fuel cells. Using results from past single | | | | |
| (U) In FY 2005: Not Applicable. | | | | | |
| Project 3145 R· | 1 Shopping List - Item No. 7-18 of 7-25 | | Exhibit R-2a (F | PE 0602203F) | |

| Exhibit R-2a, RDT&F | E Project Justification | DAT | February | 2004 |
|--|---|-------|-----------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | VITY PE NUMBER AND TITLE | | | |
| (U) | | | | |
| (U) CONGRESSIONAL ADD: Lithium-ion Battery Development. (U) In FY 2003: Developed preliminary large ampere-hour cells for littechnical issues for aircraft and Low Earth Orbit space applications paramount for Geosynchronous Earth Orbit applications. Next ger density rechargeable lithium-ion cell batteries (for future lightweig (manned and unmanned) and possibly for high power weapons and conventional, rechargeable systems by storing the same amount of | s and also addressed calendar life technical issues neration, high energy density and high power tht, less expensive advanced spacecraft and aircraft I ground support equipment) offer advantages over | 3.889 | 0.000 | 0.000 |
| (U) In FY 2004: Not Applicable. | | | | |
| (U) In FY 2005: Not Applicable. | | | | |
| | | 1.450 | 2 470 | 0.000 |
| (U) CONGRESSIONAL ADD: High-Power, Advanced Low-Mass (H (U) In FY 2003: Developed component and system technologies for the including inflatable concentrator materials and design, thermionic secondary concentrator design, thermal storage materials, and high supporting a ground demonstration of a 5 kW solar-thermionic powspace are high power (>50 kW) orbital transfer propulsion, commu Performance analyses will continue with an emphasis on studying HPALM capabilities and launch characteristics (size, weight, and c (U) In FY 2004: Design, fabricate and test prototype components supprysystem ground demonstration, including inflatable concentrator, the concentrator, thermal receiver with thermal storage and high temper of prototype components as an initial ground demo system analysis conceptual 50kW HPALM space power system based on prototype | he HPALM solar thermionic power system, cell materials and advanced converter design, a temperature power conditioning aimed at wer system. Potential HPALM applications in unication, radar or direct energy platforms. unique mission capabilities and comparing cost) to that of other space power systems. borting a 5 kW HPALM solar-thermionic power ermionic inverted converter, secondary erature power conditioning. Investigate integration s. Continue performance and mission analysis of a | 1.459 | 2.479 | 0.000 |
| (U) In FY 2005: Not Applicable. | | | | |
| (U) (U) CONGRESSIONAL ADD: Unmanned Combat Air Vehicles (UC) (U) In FY 2003: Provided hardware and technology supporting demor power extraction from an integral starter/generator for UCAV with Unmanned Combat Air Vehicles power requirements. The integra electrically, provides electrical power to support aircraft operations aircraft volume. (U) In FY 2004: Not Applicable. | nstrations, at an engine manufacturer, of integrated a focus on anticipated Navy and Air Force I starter/generator allows the engine to be started | 0.973 | 0.000 | 0.000 |
| (U) In FY 2005: Not Applicable. | | | | |
| (U) | | | | _ |
| Project 3145 | R-1 Shopping List - Item No. 7-19 of 7-25 | | Exhibit R-2a (F | PE 0602203E) |

| Exhibit R-2a, RDT&E Project | Justification | DA | DATE | | | |
|---|---|-------|-----------------|--------------|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602203F Aerospace Propulsion | | February 2004 | | | |
| (U) CONGRESSIONAL ADD: Cell-Level Battery Control. Note: Only for SBIR development. (U) In FY 2003: Not Applicable. | Phase 3 cell level battery controller | 0.000 | 0.992 | 0.000 | | |
| (U) In FY 2004: Design, fabricate, and test prototype components for monitoring a of battery energy storage systems of battery controller for Lithium Ion battery s thermal management. | | | | | | |
| (U) In FY 2005: Not Applicable.(U) | | | | | | |
| (U) CONGRESSIONAL ADD: Lightweight Photovoltaics for Portable Power And(U) In FY 2003: Not Applicable. | Hydrogen Generation. | 0.000 | 0.992 | 0.000 | | |
| (U) In FY 2004: Investigate various photovoltaic solar cells to determine performa test and integrate photovoltaic solar cells with a water electrolizer to generate h integrated into solar cell technology with a water electrolizer to generate hydrog fuel cell to support applications ranging from low power special operations to h long endurance unmanned aerial vehicles. | ydrogen. Photovoltaics will be gen. This hydrogen can be used in a | | | | | |
| (U) In FY 2005: Not Applicable. | | | | | | |
| (U)(U) CONGRESSIONAL ADD: Hypersonic Vehicle Electric Power System (HVE) | 28) Tachnology | 0.000 | 2.181 | 0.000 | | |
| (U) In FY 2003: Not Applicable. | s) rechnology. | 0.000 | 2.101 | 0.000 | | |
| (U) In FY 2004: Design, fabricate, and test a small 10-100 kilowatt demonstration | magnetohydrodynamic (MHD) | | | | | |
| generator. This demonstration includes the use of high temperature ceramic ele | | | | | | |
| cryocoolers with superconducting magnets that are integrated, but thermally iso channel with active cooling. | lated from the high temperature MHD | | | | | |
| (U) In FY 2005: Not Applicable. | | | | | | |
| (U) | | | | | | |
| (U) CONGRESSIONAL ADD: High Powered Electrical Aircraft Capabilities (Hil | PEAC). | 0.000 | 2.975 | 0.000 | | |
| (U) In FY 2003: Not Applicable. | | | | | | |
| (U) In FY 2004: Perform system analyses of high-powered electrical systems include subsystems and various component technologies. Design, fabricate, and test pri- high-powered electrical systems. HiPEAC is an electrical power system demon | ototype components that are critical to astrator and test bed that supports | | | | | |
| current and future high power systems, thus enabling new sensor, communicati | ons, and directed energy applications. | | | | | |
| (U) In FY 2005: Not Applicable.(U) | | | | | | |
| (U) CONGRESSIONAL ADD: Center for Security of Large-Scale Systems. | | 0.000 | 2.975 | 0.000 | | |
| (U) In FY 2003: Not Applicable. | | 0.000 | 2.715 | 0.000 | | |
| | List - Item No. 7-20 of 7-25 | | Exhibit R-2a (F | PE 0602203E) | | |
| | 131 | | | | | |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|--|--|---|---|---------------------|--------------------------------------|--------------------------|---------------------|----------------------------|-----------------------------------|-------------------|
| | OGET ACTIVITY Applied Research | | | | PE NUMBER A 0602203F A | ND TITLE erospace Pro | pulsion | PROJECT NUM 3145 Aerosp | | echnology |
| (U) | In FY 2004: Develop accurate, hig enhance security and survivability of heterogeneous simulation technique Configure and exercise predictive s modeling and simulation accuracy. In FY 2005: Not Applicable. Total Cost | of military install es and implement | ations and appli t their application | cations. Develo | p advanced distr of large scale s | ributed ystems. | | 31.738 | 35.162 | 24.946 |
| (U) | | marv (\$ in Milli | ons) | | | | | | | , |
| (U) (U) (U) (U) (U) (U) | Sciences. PE 0602102F, Aerospace Flight Dynamics. PE 0602605F, Directed Energy Technology. PE 0602805F, Dual Use Science and Technology. PE 0603605F, Advanced Weapon Technology. PE 0603216F, Aerospace Propulsion and Power Technology. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| Pr | oject 3145 | | F | R-1 Shopping List | - Item No. 7-21 of | 7-25 | | | Exhibit R-2a | (PE 0602203F) |

| Cost (\$ in Millions)FY 2003 ActualFY 2004 EstimateFY 2005 EstimateFY 2006 Estimate4847Rocket Propulsion Technology35.25124.89110.90312.9 | FY 2007 | | DATE PROJECT NUME | | 2004 |
|--|--|--|--|---|----------------------|
| O2 Applied Research 0602203F / Cost (\$ in Millions) FY 2003 Actual FY 2004 Estimate FY 2005 Estimate FY 2006 Estimate 4847 Rocket Propulsion Technology 35.251 24.891 10.903 12.9 | FY 2007 | | | | |
| Cost (\$ in Millions)ActualEstimateEstimate4847Rocket Propulsion Technology35.25124.89110.90312.9 | | | 4847 Rocket | Propulsion T | echnology |
| ActualEstimateEstimateEstimate4847Rocket Propulsion Technology35.25124.89110.90312.9 | E d'anne | FY 2008 | FY 2009 | Cost to | Total |
| | | Estimate | Estimate | Complete | |
| | 53 15.738 | 11.945 | 11.987 | 0.000 | 0.000 |
| Quantity of RDT&E Articles 0 0 0 Note: In FY 2003, space unique tasks in this project were transferred to PE 0602500F in conjunction with the project were transferred to PE 0602500F in conjunction were transferred to PE 0602500F in conjunction were transferred to PE 0602500F in conjunction were transferred to PE 0602500F in conjunctio | | 0 | | | |
| unique activities. In this project, space unique includes all Integrated High Payoff Rocket Propulsion Te Systems and tactical missiles. (U) <u>A. Mission Description and Budget Item Justification</u> This project develops technologies for the sustainment of strategic systems (including solid boost/ and tactical rockets. Technologies of interest will improve reliability, performance, survivability, Technologies are developed to reduce the weight and cost of components using new materials, and project are part of the Technology for the Sustainment of Strategic Systems program and support t (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> (U) MAJOR THRUST: Civilian salaries. (U) In FY 2003: This project previously included space unique funding, which were transferred to PE 5026. These funds represent the civilian salaries for the work effort transferred. | chnology activities nissile propulsion, affordability, and e improved designs ne Integrated High | s except Techno , Post Boost Co environmental of and manufact a Payoff Rocke <u>FY</u> 1 | ology for the So ontrol, aging an compatibility o uring technique | ustainment of S d surveillance e f these systems. ss. All efforts in | trategic efforts) |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. (U) (U) MAJOR THRUST: Support Post Boost Control Systems (PBCS) and solid rocket motor developm done in 0602500F, Project 5026. Efforts support the Technology for the Sustainment of Strategic S program - Phase I. Note: In FY 2005, the efforts in this activity will be moved to the Advanced To Development efforts in PE 0603216F, Project 4922. (U) In FY 2003: Not Applicable. (U) In FY 2004: Complete risk reduction efforts supporting the Phase I missile propulsion demonstration Phase I full-scale risk reduction component developments and testing to support the advanced PBC Phase I full-scale risk reduction component developments and testing to support the advanced PBC Phase I full-scale risk reduction component developments and testing to support the advanced PBC PBC Phase I full-scale risk reduction component developments and testing to support the advanced PBC PBC PBC PBC PBC PBC PBC PBC PBC PBC | ystems (TSSS) echnology on. Continue S demonstration. | | 0.000 | 1.650 | 0.000 |
| Note: Note: In FY 2005, the efforts in this activity will be moved to the Advanced Technology De in PE 0603216F, Project 4922. (U) In FY 2005: Not Applicable. (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop missile propulsion and boost technologies ballistic missile systems. Efforts support the Technology for the Sustainment of Strategic Systems Note: This effort includes a FY 2003 Congressional Add of \$5.7 million. | for tactical and program - Phase II | | 5.542 | 10.639 | 8.897 |
| Project 4847 R-1 Shopping List - Item No. 7-22 of | 7-25 | | | Exhibit R-2a (F | PE 0602203F) |

| Exhibit R-2a, RDT&E Projec | t Justification | DA | February | 2004 |
|--|---|-------|------------------------------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602203F Aerospace Propulsion | | IMBER AND TITLE et Propulsion T | echnology |
| (U) In FY 2003: Began component development and risk reduction efforts for the demonstration. Commenced verifying performance and weight improvement technology, using improved strategic propellants for future ballistic missiles. temperature, non-erosive, lightweight coated carbon-carbon ceramic and hybr motors. Commenced formulating and characterizing new propellant formulat developed the last couple years for the next phase of advanced solid propulsion. | s of rapid densification nozzle Demonstrated low-cost, high id polymer components for solid rocket ions using new fuels and oxidizers | | | |
| (U) In FY 2004: Conduct component development and risk reduction efforts for t demonstration. Verify performance and weight improvements of rapid densif improved strategic propellants for future ballistic missiles. Continue demonst non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer co Continue formulating and characterizing new propellant formulations using m last couple years for the next phase of advanced solid propulsion. Initiate dev motor modeling and simulation tools to improve industry capability to design nozzles, insulation, etc.) and motors. Continue development of advanced tact PE 0602500F, Project 5026. | the Phase II ballistic missile technology fication nozzle technology, using trating low-cost, high temperature, components for solid rocket motors. ew fuels and oxidizers developed the relopment and updates to solid rocket ballistic missile components (cases, ical propulsion components begun under | | | |
| (U) In FY 2005: Enhance component development and risk reduction efforts for a demonstration. Continue verifying performance and weight improvements of using improved strategic propellants for future ballistic missiles. Continue de non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer continue formulating and characterizing new propellant formulations using means the next phase of advanced solid propulsion. Continue n developments for solid rocket motors. Initiate component development effort demonstration. Continue development of advanced tactical propulsion component. | rapid densification nozzle technology monstrating low-cost, high temperature, omponents for solid rocket motors. ew fuels and oxidizers developed the nodeling and simulation tool s for the Phase II missile propulsion | | | |
| (U) (U) MAJOR THRUST: Develop missile propulsion technologies and aging and s Intercontinental Ballistic Missile (ICBM). Efforts support the Technology for program- Phase II. | • | 0.000 | 1.893 | 2.006 |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Initiated Phase II aging and surveillance technology development inspection tools for improved assessment of ballistic missile aging characteris (U) In FY 2005: Continue Phase II aging and surveillance technology development | tics and status. nts in analysis codes, tools, and | | | |
| inspection tools for improved assessment of ballistic missile aging characteris (U) (U) CONGRESSIONAL ADD: Cryogenic Installation for Jet and Rocket Engine propellant storage and delivery systems with related control and safety system | Test Site. Note: Only for cryogenic | 7.488 | 0.000 | 0.000 |
| Project 4847 R-1 Shoppin | ng List - Item No. 7-23 of 7-25 | | Exhibit R-2a (F | PE 0602203F) |

| Ext | nibit R-2a, RDT&E Project J | ustification | DAT | [™] February | 2004 |
|--|--|---|-----------|-----------------------|--------------|
| BUDGET ACTIVITY | | PE NUMBER AND TITLE | | MBER AND TITLE | |
| 02 Applied Research | | 0602203F Aerospace Propulsion | 4847 Rock | et Propulsion T | echnology |
| (U) In FY 2003: Upgraded the existing Jet Eng Bernardino, to enable the development test The capability installed will enable medium at Edwards Air Force Base. (D) In FX 2004. Not Applicable | ing of larger rocket engines, including | those needing cryogenic propellants. | | | |
| (U) In FY 2004: Not Applicable. | | | | | |
| (U) In FY 2005: Not Applicable.(U) | | | | | |
| (U) CONGRESSIONAL ADD: Advanced Vel center co-located with the Rocket Propulsio (U) In FY 2003: Performed initial Analysis of next stage of acquisition planning for the for capability, land-based strategic nuclear det | on Laboratory. Alternatives at the Advanced Vehicle ollowing key Air Force Space Comma | and Propulsion Center to enable the nd missions: prompt global strike | 2.430 | 4.462 | 0.000 |
| (U) In FY 2004: Continue technical support for Command missions: prompt global strike, (U) In FY 2005: Not Applicable. (U) | - | | | | |
| (U) CONGRESSIONAL ADD: Reusable Laur support RLV development. (U) In FY 2003: Upgraded space infrastructure research site to provide data on the respons (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. | e facilities at the Air Force Research L | aboratory's Edwards Air Force Base | 2.237 | 0.000 | 0.000 |
| (U) (U) CONGRESSIONAL ADD: Hybrid Polym (U) In FY 2003: Not Applicable. (U) In FY 2004: Build a pilot plant for the scal much larger quantities at much cheaper pri class of polymers for applications in liquid (U) In FY 2005: Not Applicable. | e-up of Polyhedral Oligomeric Silsesc ces and accelerating the further develo | ppment and application of this new | 0.000 | 0.992 | 0.000 |
| (U) (U) CONGRESSIONAL ADD: Engineering T initiated in a FY 2003 Congressional Add i (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop and improve modeli solid rocket motor component contribution | n PE 0602500F, Project 5026. ng and simulation tools to address space | cecraft component interactions and | 0.000 | 4.263 | 0.000 |
| Project 4847 | | ist - Item No. 7-24 of 7-25 | | Exhibit R-2a (F | PE 0602203F) |
| | | 105 | | • | |

| BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND TITLE 0602203F Aerospace Propulsion 4847 Rocket Propulsion Technology work for liquid engine system modeling and simulation tools. 0.000 0.992 0.000 (1) In FY 2005: Not Applicable. 0.000 0.992 0.000 (1) In FY 2003: Not Applicable. 0.000 0.992 0.000 (1) In FY 2003: Not Applicable. 0.000 0.992 0.000 (1) In FY 2003: Not Applicable. 0.000 0.992 0.000 (1) In FY 2003: Not Applicable. 0.000 0.992 0.000 (1) In FY 2003: Not Applicable. 0.000 0.992 0.000 (1) In FY 2003: Not Applicable. 0.000 0.992 0.000 (1) Total Cost 35.251 24.891 10.903 (2) Cother Program Funding Summary (5 in Millions) EX 2006 FY 2007 EY 2008 EY 2009 Cost to (1) Related Activities: PY 2004 Extimate Estimate Estimate Estimate Complete Total Cost (1) Related Activities: PY 2004 EY 2005 FY 2006 FY 2007 EY 2007 EY 2008 EY 2008 EX 2009 Co | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|--|--|---|------------------------------------|-------------------|--------------------|------|---------|--------|----------------|-------------------|
| (1) In FY 2005: Not Applicable. (1) CONGRESSIONAL ADD: Integrated High Payoff Rocket Propulsion Technology. (1) In FY 2003: Not Applicable. (1) In FY 2004: Conduct risk reduction effonts in the Technology for the Sustainment of Strategic Systems program-Phase I seeking a 25 percent cost reduction and 5:1 turndown ratio of a Post Boost Control Propulsion System using sustainable materials. (1) In FY 2005: Not Applicable. (2) In FY 2005: Not Applicable. (3) In FY 2005: Not Applicable. (3) In FY 2005: Not Applicable. (1) In FY 2005: Not Applicable. (2) Total Cost (3) Total Cost (4) EY 2003 EY 2004 EY 2005 EY 2006 EY 2007 EY 2008 EY 2009 Cost to Actual Estimate Estimate Estimate Estimate Estimate Complete Total Cost (1) PE 0601102F, Defense Research Sciences (2) PE 0601102F, Defense Research (3) PE 06021314N, Power Projection Applied Research. (4) PE 0602303A, Missile Trechnology. (5) PE 060311F, Ballisti Missile Trechnology. (6) PE 0603311F, Ballisti Missile Trechnology. (1) PE 0603311F, Ballisti Missile Trechnology. (1) D. Acquisition Strategy (2) Not Applicable. (3) D. Acquisition Strategy (4) Not Applicable. | | | | | | | pulsion | | | Fechnology |
| (U) Total Cost 35.251 24.891 10.903 (U) C.Other Program Funding Summary (\$ in Millions) FY 2003 FY 2004 FY 2005 FY 2007 FY 2008 FY 2009 Cost to Actual Estimate Estimate Estimate Estimate Estimate Estimate Complete Total Cost (U) Related Activities: PE 0601102F, Defense Research Sciences. Sciences. Total Cost Total Cost (U) Related Activities: PE 0602114N, Power Projection Applied Research. FY 6002303A, Missile Technology. (U) PE 0602303F, Dual Use Science and Technology. PE 0603301F, Ballistic Missile FY 2006 FY 2007 FY 2008 FY 2009 Cost it (U) PE 0603114N, Power Projection Applied Research. FY 6003303A, Missile FY 6003303A, Missile FY 6003303A, Missile FY 6003303A, Missile FY 6003301F, Ballistic Missile FY 6003301F, Ballistic Missile FY 6003401F, Advanced FY 6005401F, Advanced FY 605401F, Advanced <t< th=""><th> (U) In FY 2005: Not Applicable. (U) (U) CONGRESSIONAL ADD: Integra (U) In FY 2003: Not Applicable. (U) In FY 2004: Conduct risk reduction program-Phase I seeking a 25 perce System using sustainable materials. </th><th>tted High Payoff n efforts in the Te ent cost reduction</th><th>Rocket Propuls echnology for tl</th><th>ne Sustainment o</th><th>of Strategic Syste</th><th></th><th></th><th>0.000</th><th>0.992</th><th>0.000</th></t<> | (U) In FY 2005: Not Applicable. (U) (U) CONGRESSIONAL ADD: Integra (U) In FY 2003: Not Applicable. (U) In FY 2004: Conduct risk reduction program-Phase I seeking a 25 perce System using sustainable materials. | tted High Payoff n efforts in the Te ent cost reduction | Rocket Propuls echnology for tl | ne Sustainment o | of Strategic Syste | | | 0.000 | 0.992 | 0.000 |
| FY 2003 FY 2004 FY 2005 FY 2006 FY 2007 FY 2008 FY 2009 Cost to Actual Estimate | | | | | | | | 35.251 | 24.891 | 10.903 |
| Project 4847 Exhibit P 26 (PE 0602202E) | (U) Related Activities: PE 0601102F, Defense Research Sciences. (U) PE 0602114N, Power Projection Applied Research. (U) PE 0602303A, Missile Technology. (U) PE 0602805F, Dual Use Science and Technology. (U) PE 0603311F, Ballistic Missile Technology. (U) PE 0603401F, Advanced Spacecraft Technology. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) D. Acquisition Strategy | <u>FY 2003</u> | <u>FY 2004</u> | | | | | | | <u>Total Cost</u> |
| | Project 4847 | | | R-1 Shopping List | - Item No. 7-25 of | 7-25 | | | Exhibit R-2a (| PE 0602203F) |

PE NUMBER: 0602204F PE TITLE: Aerospace Sensors

| | Exhib | it R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 |
|------|-----------------------------------|-------------|----------|-------------|------------------------------|-----------------------|----------|----------|----------|-------|
| | TACTIVITY Died Research | | | | E NUMBER AND 602204F Aero | TITLE ospace Sense | ors | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ III Willions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| | Total Program Element (PE) Cost | 77.172 | 86.405 | 78.804 | 93.839 | 96.715 | 97.226 | 99.677 | 0.000 | 0.000 |
| 2002 | Electronic Component Technology | 19.956 | 17.126 | 15.072 | 17.021 | 19.255 | 19.813 | 20.185 | 0.000 | 0.000 |
| 2003 | EO Sensors & Countermeasures Tech | 11.881 | 18.680 | 14.657 | 15.649 | 16.139 | 16.701 | 17.061 | 0.000 | 0.000 |
| 4916 | Electromagnetic Tech | 11.906 | 12.151 | 9.536 | 9.876 | 10.273 | 10.694 | 11.134 | 0.000 | 0.000 |
| 5016 | Photonic Component Technology | 3.191 | 2.889 | 2.878 | 2.157 | 2.187 | 2.369 | 2.541 | 0.000 | 0.000 |
| 5017 | RF Processing for ISR Sensors | 7.400 | 6.643 | 7.362 | 7.726 | 7.336 | 7.599 | 7.789 | 0.000 | 0.000 |
| 6095 | Sensor Fusion Technology | 12.670 | 12.131 | 13.246 | 15.626 | 16.267 | 16.781 | 17.146 | 0.000 | 0.000 |
| 7622 | RF Sensors & Countermeasures Tech | 10.168 | 16.785 | 16.053 | 25.784 | 25.258 | 23.269 | 23.821 | 0.000 | 0.000 |

Note: In FY 2003, space unique tasks in this PE, Projects 2002, 6095, and 7622, transferred to PE 0602500F, Projects 5028 and 5029, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description and Budget Item Justification

This program develops the technology base for Air Force aerospace sensors and electronic combat. Advances in aerospace sensors are required to increase combat effectiveness by providing "anytime, anywhere" surveillance, reconnaissance, precision targeting, and electronic warfare capabilities. To achieve this progress, this program pursues simultaneous advances in: 1) generating, controlling, receiving, and processing electronic and photonic signals for radio frequency (RF) sensor aerospace applications; 2) electro-optical aerospace sensor technologies for a variety of offensive and defensive uses; 3) RF antennas and associated electronics for airborne surveillance, together with active and passive electro-optical sensors; 4) technologies to manage and fuse on-board sensor information for timely, comprehensive situational awareness; and 5) technology for reliable, all-weather surveillance, reconnaissance, and precision strike radio frequency sensors and electronic combat systems. Note: In FY 2004, Congress added \$2.4 million for Three-Dimensional (3-D) Packaging Technology for High Speed RF Communication, \$3.2 million for the Watchkeeper Ultra Wideband Demonstration, \$3.0 million for the Center for Advanced Sensor and Communication Antennas, and \$3.0 million for the General Purpose reconfiguration Signal Processors System. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary sensor, electronics, and electronic combat technologies.

R-1 Shopping List - Item No. 8-1 of 8-27

| Exhibit R-2, RDT&E B | Budget Item Justification | DATE Februa | ary 2004 |
|--|---|----------------|---------------|
| DGET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602204F Aerospace Sensors | | |
|) B. Program Change Summary (\$ in Millions) | | | |
| | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 200</u> |
|) Previous President's Budget | 76.743 | 75.577 | 84.11 |
|) Current PBR/President's Budget | 77.172 | 86.405 | 78.80 |
|) Total Adjustments | 0.429 | 10.828 | |
|) Congressional Program Reductions | | -0.030 | |
| Congressional Rescissions | | -0.742 | |
| Congressional Increases | | 11.600 | |
| Reprogrammings | 1.227 | | |
| SBIR/STTR Transfer | -0.798 | | |
| <u>Significant Program Changes:</u> Changes to this program since the previous President's Budget ar | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

R-1 Shopping List - Item No. 8-2 of 8-27

| | Ext | nibit R-2a, F | RDT&E Pro | oject Justif | fication | | | DA | February | 2004 |
|---|--|---|---|--|---|---|--|---|--|--|
| | T ACTIVITY plied Research | | | | PE NUMBER AND 0602204F Aero | | ors | | UMBER AND TITLE tronic Compone gy | ent |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | O Cost to | Total |
| | Cost (\$ III WIIIIolis) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | e Complete | |
| 2002 | Electronic Component Technology | 19.956 | 17.126 | 15.072 | | 19.255 | 19.813 | 20.1 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles In FY 2003, efforts in photonic component | 0 | 0 | 0 | - | 0 | 0 | | 0 | |
| to PE 060 (U) | A. Mission Description and Budget Item This project focuses on generating, contro- technologies developed under this project technologies developed include: solid sta distribution; signal processing; multi-func distribution; multi-chip modules; and high integrating combinations of these electron weight, lower cost, lower power dissipation military unique; they are based on Air For | nction with the n Justification olling, receiving will be used fo te power device ction monolithic n density packag- nic component to on, higher reliab | Space Commis , and processin r intelligence, s and amplifie integrated circ ging and interce echnologies. T pility, and impr | ssion recomme ng electronic si surveillance, re rs; low noise a cuits; high-spe onnect technol The project aim oved performa | endation to conse ignals for radio f econnaissance (I and signal contro ed analog-to-dig logies. This pro ns to demonstrat ance. The device | Frequency (RF) SR), electronic of components; sital and digital- ject also design e significantly i e and compone | e unique activi sensor aerosp warfare (EW high-temperat to-analog miz s, develops, fa improved mili nt technology | ities. ace applicat), and precis ure electron ked mode in abricates, an tary sensors developmen | ions. The enabling sion engagement. T ics; signal control tegrated circuits; p id evaluates technic of smaller size, lo nts under this proje | g The and ower ques for wer ct are |
| (U) <u>B</u> (U) M (U) In n b ra n (U) In s c c (a (1) (U) In n | smart weapons. Accomplishments/Planned Program (MAJOR THRUST: Develop compact, affer ommunications, Global Positioning System n FY 2003: Tested Gallium Arsenide and hixers, etc.) inserted into radar and EW dig rassboard low-power (< 1.0W), silicon-or adiation testing in a space-qualified packan hicrowave, etc.) integrated circuit, for recon- n FY 2004: Develop receiver architecture systems, such as multiple channel coherence alibration. Evaluate in a relevant environmanalog-to-digital converters, filters, mixer (nP) RF components into radar and EW did n FY 2005: Develop a DBF receiver archi- nultiple channels, support for digital true t | ordable, multi-f m, radar, EW, a Indium Phosph gital receiver m n-sapphire based ge. Laboratory onfigurable sign e and componen ce of multi, digi ment affordable s, etc.), together igital receiver m itecture address | nd other ISR s ide RF compo odules against d analog-to-dig tested a silicon al conversion. ts addressing is tal true time de Gallium Arsen with the techr odules. ing issues spec- nel equalization | ensors. nents (analog- environment s ital converter a n-on-insulator ssues specific t elay support, cl nide (GaAs) R nology upgrade cific to DBF sy on, and array ca | to-digital conver scenarios. Demo and completed g mixed-signal (d to digital beamfor hannel equalizat F components e plan for Indium ystems, such as c alibration. Evalu | rters, filters, onstrated a ground-level igital, RF, orming (DBF) ion, and array n Phosphide coherence of uate affordable | | <u>7 2003</u> 3.858 | <u>FY 2004</u> 2.606 | <u>FY 2005</u> 5.107 |
| Projec | ct 2002 | | R-1 S | hopping List - Ite | em No. 8-3 of 8-27 | , | | | Exhibit R-2a (| PE 0602204F) |

| Exhibit R-2a, RDT&E Pr | oject Justification | DA | | 2004 |
|--|---|-------|--|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602204F Aerospace Sensors | | February 2004 T NUMBER AND TITLE Electronic Component ology | |
| DBF-specific Gallium Arsenide (GaAs) RF components (ADCs, filters | | | | |
| plan for Indium Phosphide (InP) RF components into radar and EW dig (U) | ghai receiver modules. | | | |
| (U) MAJOR THRUST: Develop microwave technologies for advanced rad antennas used in military intelligence, surveillance, and reconnaissance | | 3.350 | 2.298 | 0.824 |
| (U) In FY 2003: Developed and demonstrated robust components for L-ba channels that operate with limited environmental controls and under set | nd and X-band transmitter and receiver | | | |
| (U) In FY 2004: Develop and demonstrate the proof of concept of transmit withstand strong undesired electromagnetic signals. | • | | | |
| (U) In FY 2005: Develop and demonstrate the proof of concept of limited s that are able to withstand extreme temperature and signal environments | | | | |
| (U) | • | | | |
| (U) MAJOR THRUST: Develop integration and assembly technologies for | high performance aerospace phased array | 4.050 | 2.039 | 1.921 |
| sensors. (U) In FY 2003: Demonstrated X-band, flexible RF membrane-based sub-a | assemblies that enable integrating low-cost and | | | |
| low-mass transmitter and receiver channels at the subarray level. | | | | |
| (U) In FY 2004: Develop and demonstrate large area (>0.5 m2) active aper | tures based on flexible RF membranes that | | | |
| lower the assembly costs and mass over conventional phased arrays by | an order of magnitude. | | | |
| (U) In FY 2005: Develop and demonstrate the complex integration of mult | iple functions on flexible RF substrates for | | | |
| application on conformal surfaces such as those found on aerospace vel | nicles. | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop signal control and low-power consumption power loss and power consumption for future radar, electronic warfare | | 4.310 | 2.738 | 4.477 |
| (U) In FY 2003: Characterized and matured micro-electro-mechanical syst switch lifetimes. Reduced the power consumption of low-noise amplifi- bandwidths. | ems wideband phase shifters for extended | | | |
| (U) In FY 2004: Fabricate subarrays with T/R channels that feature a five- maintaining high linearity over wide bandwidths. | fold power consumption reduction, while | | | |
| (U) In FY 2005: Develop new T/R channel technology using advanced sen | niconductor integration techniques. | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Refine materials and processes for two-dimensional | al and three-dimensional device interconnects | 2.430 | 1.300 | 1.097 |
| and component protection from the environment. | | | | |
| (U) In FY 2003: Verified that these interconnects and components perform of high density mixed-signal technologies (digital, analog, microwave a | • | | | |
| | Shopping List - Item No. 8-4 of 8-27 | | Exhibit R-2a (F | |
| | 140 | | | L 00022041) |

| Exhibit R-2a, RDT&E Pro | DA | DATE February 2004 | | | | |
|---|---|-----------------------|-----------------|--------------|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602204F Aerospace Sensors | | IMBER AND TITLE | | | |
| Tested interconnects and components in both packaged (non-hermetic m (bare-die-chip on board) forms. | nulti-chip modules) and package-less | | | | | |
| (U) In FY 2004: Develop and demonstrate mixed-signal receiver/processor | multi-functionality on flexible arrays using | | | | | |
| advanced two-dimensional and three-dimensional interconnects, and pac | ckage-less protection schemes. Verify the | | | | | |
| electrical performance of these mixed-signal assemblies and validate the | eir hermetic-like protective qualities. | | | | | |
| (U) In FY 2005: Demonstrate and evaluate a two-fold decrease in the cost a | nd size of the mixed-signal assemblies. | | | | | |
| (U) | | | | | | |
| (U) MAJOR THRUST: Evaluate the integrated tool suite in the modeling, s | • | 0.000 | 0.893 | 1.646 | | |
| environment for mixed-signal (digital, radio frequency (RF), microwave | e, etc.) component development in both | | | | | |
| advanced and emerging electronic component technologies. | | | | | | |
| (U) In FY 2003: Not Applicable. In FY 2003, this work was performed und | · · · | | | | | |
| (U) In FY 2004: Laboratory test breadboard silicon-on-insulator and silicon | | | | | | |
| designed for precise positioning, navigation, and other aerospace applica | | | | | | |
| (U) In FY 2005: Evaluate system-in-a-package/system-on-a-chip tool suite | · · · | | | | | |
| characterization of mixed-signal (digital, RF, microwave, etc.) compone | | | | | | |
| technologies (silicon-on-insulator (SOI), Silicon Germanium (SiGe), An | | | | | | |
| a laboratory environment breadboard SOI and SiGe signal conversion co Positioning System, air moving target indication) aerospace applications | | | | | | |
| (U) | 5. | | | | | |
| (U) CONGRESSIONAL ADD: Wireless Surveillance of Hostile Threats. | | 0.979 | 0.000 | 0.000 | | |
| (U) In FY 2003: Developed low-temperature, high-efficiency, small-scale fit | uel cells to generate power for wireless | 0.979 | 0.000 | 0.000 | | |
| micro-sensor systems that will provide "anytime, anywhere" ISR capabi | | | | | | |
| (U) In FY 2004: Not Applicable. | | | | | | |
| (U) In FY 2005: Not Applicable. | | | | | | |
| (U) | | | | | | |
| (U) CONGRESSIONAL ADD: Advanced Fourier Transform-Infrared (FT- | IR) Gas Analysis. | 0.979 | 0.000 | 0.000 | | |
| (U) In FY 2003: Demonstrated FT-IR spectrometric gas analysis techniques | s for applications in controlling reactant gases | | | | | |
| generated during the vapor phase epitaxial growth of semiconductor film | ns on substrates. These techniques will also | | | | | |
| be used to monitor gas concentrations in nanostructure growths for elect | ronic and optical devices, and in the | | | | | |
| development of new approaches to detecting chemical and biological ag | ents. | | | | | |
| (U) In FY 2004: Not Applicable. | | | | | | |
| (U) In FY 2005: Not Applicable. | | | | | | |
| | | 0.000 | | 0.000 | | |
| (U) CONGRESSIONAL ADD: 3-D Packaging Technology for High Speed | | 0.000 | 2.326 | 0.000 | | |
| Project 2002 R-1 S | Shopping List - Item No. 8-5 of 8-27 141 | | Exhibit R-2a (I | PE 0602204F) | | |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | | DATE February | 2004 | |
|---|--|---|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------|--|-------------------|--|
| BUDGET ACTIVITY 02 Applied Research | | | | 0602204F Aerospace Sensors 2002 I | | | | ECT NUMBER AND TITLE Electronic Component nology | | |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Design, fabricate, and o speed electrical and high-power ther. (U) In FY 2005: Not Applicable. | | | | D microcircuit pa | ackages for high | | • | | | |
| (U) (U) CONGRESSIONAL ADD: General (U) In FY 2003: Not Applicable. (U) In FY 2004: Accelerate the develop intelligence, surveillance, and recommendation | ment and transit | ion of new on-t | oard sensor sign | nal processors fo | r time-critical | | 0.000 | 2.926 | 0.000 | |
| (U) In FY 2005: Not Applicable.(U) Total Cost | | | | | | | 19.956 | 17.126 | 15.072 | |
| (U) <u>C. Other Program Funding Summ</u> (U) Related Activities: PE 0602500F, (U) Multi-disciplinary Space Technology. (U) PE 0603203F, Advanced Aerospace Sensors. (U) PE 0603270F, Electronic Combat Technology. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate | <u>nary (\$ in Milli(</u> <u>FY 2003</u> <u>Actual</u> | <u>ons</u>) <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 20</u> <u>Estin</u> | | <u>Total Cost</u> | |
| duplication. D. Acquisition Strategy Not Applicable. | | | | | | | | | | |
| Project 2002 | | | | - Item No. 8-6 of 8 142 | 3-27 | | | Exhibit R-2a | (PE 0602204F) | |

| | Exh | nibit R-2a, I | RDT&E Pro | ject Justif | fication | | | DATE | February | 2004 |
|------|--|--|--|---|---|--|--|---|--|---------------------------|
| | GET ACTIVITY Applied Research | | | | PE NUMBER AND 0602204F Aer | | ors | | IBER AND TITLE nsors & Coun | termeasures |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 2003 | | 11.881 | 18.680 | 14.657 | | 16.139 | 16.701 | 17.06 | | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | (|) | |
| (U) | A. Mission Description and Budget Item This project determines the technical feasi technologies under development range fro digital processing, analysis tools, and sens identification of non-cooperative and diffi sensors and algorithms needed to enable p goals include advanced EO threat warning | bility of advan- om the ultraviol sor architectures cult targets, suc- precision targeti | et through the i s. One of the p ch as those obs ng in severe w | infrared (IR) p project's main g cured by camo | ortion of the spe goals is to impro ouflage. This pro | ectrum. Related ove EO and rela oject also devel | l efforts includ ted technologi ops the passiv | le improvement es for the dete e and active h | nts in avionics in ction, tracking, a yperspectral ima | tegration, and ging |
| (U) | B. Accomplishments/Planned Program (| <u>\$ in Millions)</u> | | | | | <u>FY</u> | <u>2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| | MAJOR THRUST: Develop technology for | - | | | - | - | | 3.180 | 3.810 | 2.928 |
| | In FY 2003: Conducted air-to-air and air-to sensors. Tested range-resolved coherent in algorithms. Conducted long-range experim hyperspectral model development, validation processing performance based on ground do multi-function laser radar for identification | hage processing nents using adv. on, and perform emonstration da of ground targ | and extraction anced 3-D sens nance prediction ata. Continued ets. | n algorithms, in sors for CID ap ns, and assessed flights, analys | ncluding 3-D blo oplications. Cor ed signature-bas sis, and evaluation | ock registration ntinued passive ed data on of | | | | |
| (U) | In FY 2004: Conduct ground- and air-base system with multi-spectral detection and cu- identification sensors. Integrate advanced, system to detect targets in relevant environm performance predictions specifically suppo- approaches for deep penetration and contin | eing, and activ 3-D focal plane ments. Continu rting the flying | e electro-optica es and algorithm ne passive hype testbed. Defin | al (EO) target l ms in a concep erspectral mod | long-range com ot design of a hig el development, | bat gh altitude validation, and | I | | | |
| | In FY 2005: Continue ground- and air-base polarization-based detection and cueing and integration of advanced 3-D focal planes ar technology demonstrations in relevant confi region and perform validation experiments passive polarization techniques into both m architectures for layered sensing based on r | ed testing and c d active EO targ ad algorithms in figurations. Ex- with flying test odeling and pe | lemonstration of get long-range in concept designed tend passive hy- bed. Extend p rformance assess in types for dea | combat identif on of high altitu perspectral mo assive EO/IR of essments. Dev ep penetration | fication sensors. ude system and odel to emissive enhancements b elop electro-opt and continuous | Complete perform spectral y incorporating ical system target area | | | | |
| Pro | ject 2003 | | R-1 S | hopping List - Ite | em No. 8-7 of 8-27 | 7 | | | Exhibit R-2a (| PE 0602204F) |

| Exhibit R-2a, RDT&E Projec | DATE February 2004 | | | |
|---|--|-------|-------------------------------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602204F Aerospace Sensors | | NUMBER AND TITLE Sensors & Count | termeasures |
| coverage. | | | | |
| (U) (U) MAJOR THRUST: Develop optical transmitter technology capable of sensing robust non-cooperative target identification. (U) In FY 2003: Developed pulsed vibration sensing system for long-range comb | | 2.076 | 2.014 | 2.429 |
| developing flight-capable, multi-function architectures. Integrated platform co architectures. Developed breadboard multi-spectral transmitter, and predicted targets. | ompensation techniques into new | | | |
| (U) In FY 2004: Laboratory demonstrate a multi-function, pulsed vibration imagi Test and evaluate sensors utilizing 3-D focal planes. Continue developing flig Continue fabricating a breadboard multi-spectral transmitter and evaluate perf | ght capable multi-function architectures. | | | |
| (U) In FY 2005: Evaluate performance of multi-function pulsed vibration/imaging Complete breadboard active multi-spectral transmitter and evaluate performar Initiate flight capable, long-range, multi-function brassboard sensor developm support testing of long-range air-to-air and air-to-ground systems under develop pulsed vibrometer CID sensor. | nce for both hard and extended targets. nent. Tailor flight test platform to | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop innovative techniques and components to target atmospheric conditions. | difficult objects in degraded | 4.029 | 7.510 | 7.636 |
| (U) In FY 2003: Continued utility analysis of high altitude active sensors, includi tests of an active multi-spectral imaging system. Demonstrated imaging throu field to the function of the sensor of the senso | igh weather and obscurants through | | | |
| flight test of active imaging sensors. Designed and demonstrated concepts bas gating, and image processing. Developed concepts for airborne application of devices, including mitigating aero-optical effects. Investigated concepts for co electro-optical (EO) apertures. | f non-mechanical beam steering | | | |
| (U) In FY 2004: Develop high altitude active sensor performance specifications a and obscurant penetration concepts. Initiate evaluating non-mechanical beam sensor applications including precision pointing, focusing, and wavefront corr demonstration of a combined EO and radio frequency aperture. Perform tests, specialized multi-function laser radar for the detection and characterization of | steering concepts for high altitude rection. Perform an initial analyses, and evaluations of a | | | |
| (U) In FY 2005: Complete high altitude active sensor performance specification a evaluation of and demonstrate non-mechanical beam steering concepts for hig precision pointing, focusing, and wavefront correction. Continue developmen EO/radio frequency (RF) aperture. Continue tests, analysis and evaluation of | and concept design. Complete the gh altitude sensor application including and demonstrations of a combined | | | |
| Project 2003 R-1 Shoppi | ing List - Item No. 8-8 of 8-27 | | Exhibit R-2a (I | PE 0602204F) |

| Exhibit R-2a, RDT | &E Project Justification | DA | February | 2004 |
|---|--|-------|-----------------------------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602204F Aerospace Sensors | | IMBER AND TITLE ensors & Count | termeasures |
| detection and characterization of difficult targets. Collect simul phenomenology data for analysis of difficult target detection. In electro-optics unmanned aerial vehicle (UAV) based systems to environments including the urban environment. Study integration EO/infrared for enhanced search, detection, location, and identified (U) | nitiate architecture definition for advanced find, fix, and identify difficult targets in difficult on techniques for combining active and passive | | | |
| (U) MAJOR THRUST: Develop countermeasure technologies for u electro-optical threats. (U) In FY 2003: Continued to design components and refine technic exploitation of advanced IR missile technology. | | 1.947 | 1.149 | 0.832 |
| (U) In FY 2004: Complete an IR scene projector to assess imaging offboard techniques to defeat imaging missile seekers. Continue technologies | | | | |
| (U) In FY 2005: Develop specifications for countermeasure techniq Continue the exploitation of advanced infrared missiles and infr refinement. Initiate characterization of an imaging missile seeke | ared sensor technology for countermeasure technique | | | |
| (U) (U) MAJOR THRUST: Develop aerospace missile and laser warnin (U) In FY 2003: Laboratory tested temporal and spectral tracking a techniques. Initiated the testing of an advanced laser warning re (U) In FY 2004: Continue laboratory testing temporal and spectral techniques. Continue testing an advanced laser warning receive testing to include airborne applications. | lgorithms focused on multi-spectral imaging ecceiver for application in a space environment. tracking algorithms focused on multi-color imaging | 0.649 | 0.997 | 0.832 |
| (U) In FY 2005: Evaluate advanced multi-color spectral sensor tech enhanced clutter discrimination techniques for tactical missile w warning receiver for space and airborne applications. Initiate de for satellite-as-a-sensor technology evaluations. Initiate develop ultra-short and tunable laser threats. | varning. Continue developing an advanced laser eveloping a space-based laser threat scenario testbed | | | |
| (U) (U) CONGRESSIONAL ADD: Watchkeeper Ultra-Wideband (UW) (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop ultra-wideband radio frequency technolog defense. | | 0.000 | 3.200 | 0.000 |
| (U) In FY 2005: Not Applicable.Project 2003 | R-1 Shopping List - Item No. 8-9 of 8-27 | | Exhibit R-2a (F | |
| 110/00/2000 | | | | L 00022041) |

| | | Exhibit R- | -2a, RDT&E | Project Ju | stification | | | | DATE February | 2004 | | |
|-----|--|--------------------------|-----------------|-------------------|--------------------|-----------------|-----------------|--------------|---|---------------|--|--|
| | GET ACTIVITY Applied Research | | | | | | | | CT NUMBER AND TITLE EO Sensors & Countermeasures | | | |
| (U) | Total Cost | | | | | | | 11.881 | 18.680 | 14.657 | | |
| (U) | C. Other Program Funding Sum | <u>mary (\$ in Milli</u> | ons) | | | | | | | | | |
| | | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 20</u> | | Total Cost | | |
| an | Related Activities: | <u>Actual</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estin</u> | nate <u>Complete</u> | | | |
| (0) | PE 0602500F, | | | | | | | | | | | |
| (U) | Multi-disciplinary Space | | | | | | | | | | | |
| | Technology. | | | | | | | | | | | |
| (U) | PE 0603253F, Advanced Sensor Integration. | | | | | | | | | | | |
| | PE 0602301E, Intelligence | | | | | | | | | | | |
| (U) | System Program. | | | | | | | | | | | |
| | This project has been | | | | | | | | | | | |
| (U) | coordinated through the Reliance process to harmonize | | | | | | | | | | | |
| (0) | efforts and eliminate | | | | | | | | | | | |
| | duplication. | | | | | | | | | | | |
| (U) | D. Acquisition Strategy | | | | | | | | | | | |
| Ì | Not Applicable. | | | | | | | | | | | |
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| Pro | oject 2003 | | | R-1 Shopping List | - Item No. 8-10 of | 8-27 | | | Exhibit R-2a | (PE 0602204F) | | |

| | | | | UNCLAS | | | | | | | |
|-----|---|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---|-------|---------------------|----------------|
| | Ext | nibit R-2a, F | RDT&E Pro | ject Justifi | ication | | | | DATE | February | 2004 |
| | GET ACTIVITY Applied Research | | | | E NUMBER AND | | ors | PROJECT NUMBER AND TITL ors 4916 Electromagnetic T | | | :h |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | | Cost to Complete | Total |
| 491 | 6 Electromagnetic Tech | 11.906 | 12.151 | 9.536 | 9.876 | 10.273 | 10.694 | 1 | 1.134 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | |
| (U) | | | | | | | | | | | |
| an | B. Accomplishments/Planned Program (8 | \$ in Millions) | | | | | FY | <u> 2003</u> | | FY 2004 | <u>FY 2005</u> |
| | MAJOR THRUST: Investigate detecting d | | e and ground-b | ased targets in | clutter from air | borne or | <u> </u> | 2.824 | | 2.269 | 2.510 |
| Ì. | space-based surveillance platforms. | | C | C | | | | | | | |
| (U) | In FY 2003: Developed models and experi | mental techniqu | ues for characte | erizing RF scat | ter from targets | s, ground | | | | | |
| | clutter, and foliage. | | | | | | | | | | |
| (U) | In FY 2004: Continue developing models a scattering from targets, ground clutter, and | | al techniques f | or the character | rization of RF f | requency | | | | | |
| | In FY 2005: Develop and validate target at parametric description of radar signal scatter | | | | nt techniques fo | or the | | | | | |
| (U) | | · · · · · · | | | | | | 2 7 4 0 | | 2 420 | 0.550 |
| | MAJOR THRUST: Design and develop ar | | - | | | | | 2.740 | | 2.429 | 2.552 |
| (0) | In FY 2003: Designed, analyzed, and built for digital beam forming and limited-scan p end applications and micro-electro-mechan | phased array and | ennas. Develo | pped high-spee | d electronics fo | r antenna front | | | | | |
| (U) | In FY 2004: Evaluate advanced large, ligh | | | | | | | | | | |
| (-) | and limited-scan phased array antennas. Ev | - | • | - | - | - | | | | | |
| | micro-electro-mechanical systems technolo | 0 1 | | | | | | | | | |
| (U) | In FY 2005: Extend the design and analysi | s of advanced 1 | arge lightweig | ht array antenn | as. Initiate fab | ricating | | | | | |
| | breadboard large lightweight array antenna | s. Develop new | algorithms for | multi-beam di | igital beam forr | ning and | | | | | |
| | limited-scan phased array antennas. Valida | 0 1 | | | | d | | | | | |
| | micro-electro-mechanical systems technology | gy for delay lin | e switching in | phased arrays. | | | | | | | |
| (U) | | | | | | | | | | | |
| (U) | MAJOR THRUST: Design and develop ne | ew EO techniqu | es and compor | nents for detect | ing and identify | ying concealed | | 2.572 | | 2.179 | 2.237 |
| Pro | ject 4916 | | R-1 Sh | nopping List - Iter | m No. 8-11 of 8-2 | 7 | | | | Exhibit R-2a (I | PE 0602204F) |
| | | | | 147 | 7 | | | | | | |

| Exhibit R-2a, RDT& | E Project Justification | DA | February | 2004 |
|---|--|-------|-----------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602204F Aerospace Sensors | | IMBER AND TITLE | |
| targets. (U) In FY 2003: Designed and fabricated multi-function sensor array technologies for optical beam steering. Designed and developed a autonomous 3-D ladar-guided munitions and other imaging applic that compensate for optical aberration in aircraft-generated turbul. (U) In FY 2004: Continue designing and fabricating multi-function settle technologies for optical beam steering. Continue designing and d techniques for autonomous 3-D laser radar-guided munitions and optical processing techniques that compensate for optical aberration. (U) In FY 2005: Evaluate multi-function, multisensor optical arrays a for optical beam steering. Evaluate active components and integr laser-radar-guided munitions and other imaging applications. Evaluate aberration in aircraft-generated turbulence. | active components and integration techniques for cations. Developed optical processing techniques ence. ensor arrays and the associated materials and device leveloping active components and integration other imaging applications. Continue developing ons in aircraft-generated turbulence. and the associated materials and device technologies ation techniques for autonomous 3-D | | | |
| (U)(U) MAJOR THRUST: Develop hardware and software for passive r | nulti-dimensional sensing in the thermal infrared | 2.791 | 2.274 | 2.237 |
| spectral wavelength range at high frame rates. (U) In FY 2003: Established viability of tomographic hyperspectral s Demonstrated the applicability of tomographic hyperspectral sens launches, and to developing techniques for real-time bomb-damag (U) In FY 2004: Evaluate the viability of tomographic hyperspectral Evaluate the applicability of tomographic hyperspectral sensor co | ensing techniques for aerospace applications. sor concepts to characterizing explosions and missile ge assessment. sensing techniques for aerospace applications. | | | |
| (U) In FY 2005: Initiate developing technology for a new dual band to characterizing energetic battlefield events in real-time. Develop t dual-band information to increase the validity of target declaration | ge assessment. tomographically based sensor system for echniques that use hyperspectral, simultaneous | | | |
| | | 0.070 | 0.000 | 0.000 |
| (U) CONGRESSIONAL ADD: Phased Array Antenna and Control S (U) In FY 2003: Developed a phased array antenna control system by antenna's beam pointing, and by developing the computer hardwa antenna operations and the antenna's health and status. (U) In FY 2004: Not Applicable. | implementing computer algorithms that control the | 0.979 | 0.000 | 0.000 |
| (U) In FY 2005: Not Applicable. | | | | |
| (U) | | | | |
| (U) CONGRESSIONAL ADD: Center for Advanced Sensor and Cor | nmunication Antennas. | 0.000 | 3.000 | 0.000 |
| (U) In FY 2003: Not Applicable. | | | | |
| Project 4916 | R-1 Shopping List - Item No. 8-12 of 8-27 148 | | Exhibit R-2a (F | PE 0602204F) |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 | | |
|---------------------------|---|--------------------------|-----------------|---|----------------------|-----------------|-----------------|-----------------|---|-------------------|--|--|
| BUDGET ACTI 02 Applied | | | | PE NUMBER AND TITLE 0602204F Aerospace Sensors | | | | | PROJECT NUMBER AND TITLE 4916 Electromagnetic Tech | | | |
| prolifera | 004: Develop innovative, lo tion of advanced phased arr 005: Not Applicable. 0st | U | | | ieve high perfor | mance and | | 11.906 | 12.151 | 9.536 | | |
| (U) <u>C. Othe</u> | er Program Funding Sumi | <u>mary (\$ in Milli</u> | <u>ons)</u> | | | | | | | | | |
| | | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> | Cost to | <u>Total Cost</u> | | |
| (U) Related PE 0602 | | <u>Actual</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Complete</u> | | | |
| Technol PE 0602 | 1 1 1 | | | | | | | | | | | |
| This pro coordina | and Communications: oject has been ated through the e process to harmonize | | | | | | | | | | | |
| | and eliminate | | | | | | | | | | | |
| | uisition Strategy plicable. | | | | | | | | | | | |
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| | | | | | | | | | | | | |
| Project 4916 | | | F | R-1 Shopping List | - Item No. 8-13 of 8 | 8-27 | | | Exhibit R-2a (| PE 0602204F) | | |

| | Ext | nibit R-2a, I | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|--|---|---|---|---|---|--|---|--|---|---|
| | ET ACTIVITY pplied Research | | | | PE NUMBER AND D602204F Aer | | ors | PROJECT NUME 5016 Photon Technology | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 5016 | | 3.191 | 2.889 | 2.878 | 1 | 2.187 | 2.369 | | 0.000 | 0.000 |
| | Quantity of RDT&E Articles In FY 2003, photonic component technol | 0 | 0 | 0 | Ŷ | 0 | 0 | 0 | | |
| (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 | A. Mission Description and Budget Iter This project focuses on designing and dev sensor aerospace applications. Enabling t engagement sensors include: low noise, as signals; electro-optical components for RI circuits; wideband photonic-based high-sp designs, develops, fabricates, and evaluate significantly improved military sensors of current systems. The device, component, Defense weapon systems requirements in B. Accomplishments/Planned Program (MAJOR THRUST: Develop integrated ph In FY 2003: Developed high-performance components and subsystems for wideband aerospace sensors and communication syst In FY 2004: Evaluate high-performance in and subsystems for wideband radio frequen aerospace sensors and communication syst In FY 2005: Laboratory test and validate h switching components and subsystems for | veloping method ecchnologies de erospace enviro F links; photoni peed EO analog es techniques for f smaller size, lo and subsystem the areas of rad \$ in Millions) totonic technolog integrated photon RF phased array ems. htegrated photon ncy phased array ems. high-performance | veloped under nmentally-qua c signal contro -to-digital and or integrating v ower weight, lo technology de ar, sensors, co gy component onic technology y antenna bean hic technology y antenna bean ce integrated pl frequency pha | this project for lified signal co l, distribution, digital-to-anal arious combina ower cost, lowe velopments un mmunications, s. gy link, interco nforming and c link, interconn nforming and c | intelligence, su introl component and signal proc og converters; a ations of photon er prime power, der this project EW, navigation nnect, and switch control, and for l logy link, interce | rveillance, reco ats (e.g., electro essing; multi-fi and opto-electro higher reliabili are military un n, and smart wo ching high data rate ing component high data rate connect, and | onnaissance, el o-optical (EO) unction, aerosponic intraconne ic technologies ty, and improv ique and based eapons. | lectronic warfar switches, micro pace-qualified, o ects and intercon s. The main pur- red performance | e (EW), and pre- opto-electronic opto-electronic innects. This pro- rpose is to demo | ecision c mixed integrated oject onstrate l to |
| (U) (U) 1 (U) 1 t | and for high data rate aerospace sensors an MAJOR THRUST: Develop photonic ana In FY 2003: Developed ultrafast, wideban technology. In FY 2004: Evaluate, test, and validate ul | log-to-digital co d photonic anal | onversion compog-to-digital m | nixed signal co | nversion compo | | | 1.142 | 0.741 | 0.000 |
| | component technology. ect 5016 | | - | | m No. 8-14 of 8-2 | | | | Exhibit R-2a (F | PE 0602204F) |

| | Exhibit R- | 2a, RDT&E | | stification | | | DATE | Fahruari | 2004 | |
|---|---|-----------------------------|---|----------------------|---------------------|---------------------|---|---------------------|-------------------|--|
| BUDGET ACTIVITY 02 Applied Research | | | PE NUMBER AND TITLE 0602204F Aerospace Sensors | | | | February 2004 PROJECT NUMBER AND TITLE 5016 Photonic Component Technology | | | |
| (U) In FY 2005: Not Applicable. Wo(U) Total Cost | ork completed. | | | | | | 3.191 | 2.889 | 2.878 | |
| (U) <u>C. Other Program Funding Sun</u> (U) Related Activities: PE 0602500F, (U) Multi-disciplinary Space Technology. (U) PE 0603203F, Advanced Aerospace Sensors. (U) PE 0603270F, Electronic Combat Technology. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. | mmary (\$ in Milli FY 2003 Actual | ons) FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | <u>Total Cost</u> | |
| Project 5016 | | F | | - Item No. 8-15 of 8 | 3-27 | | | Exhibit R-2a (| PE 0602204F | |

| | Ex | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|------------|---|---|---|--|---|--|---------------------|------------------------|-------------------------|-------------------------|
| | GET ACTIVITY Applied Research | | | | PE NUMBER AND 1602204F Aer | | ors | PROJECT NUME | BER AND TITLE | R Sensors |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| 501 | 7 RF Processing for ISR Sensors | 7.400 | 6.643 | 7.362 | 7.726 | 7.336 | 7.599 | 7.789 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | e: In FY 2003, efforts in radio frequency (I sferred to this project. | RF) processing fo | or intelligence, | surveillance, a | and reconnaissa | nce (ISR) sense | ors previously | performed in th | is PE, Project 7 | 622, |
| (U) | A. Mission Description and Budget Ite This project develops and assesses radar targets that have difficult to detect signat exploited include the use of multiple radi processing techniques. | technology for a ures due to reduce | ced cross section | ons, concealme | ent and camoufl | age measures, s | severe clutter, | or heavy jammi | ing. Technique | s |
| | B. Accomplishments/Planned Program MAJOR THRUST: Develop distributed a | | vstems to incre | ase sensitivity | and improve lo | cation | <u>FY</u> | <u>′ 2003</u> 1.038 | <u>FY 2004</u> 0.498 | <u>FY 2005</u> 0.407 |
| (U) | accuracy. In FY 2003: Investigated RF processing t sensitivity and improve location accuracy improved location accuracy using interfer selections. In FY 2004: Demonstrate, through compu- implementing distributed airborne sensing targets. In FY 2005: Demonstrate in the laborator distributed airborne sensing techniques for | These techniques metric methods of uter simulation a g techniques for of ty the proof of co | nd emulation, t detecting, locat | rse arrays with knowledge-ba he RF process ing, and engag rocessing techn | maneuvering p ised responsive ing techniques ing airborne an iques for imple | latforms and mode for d ground menting | | | | |
| (U) (U) | MAJOR THRUST: Investigate technique In FY 2003: Investigated common wavef for both unconcealed and concealed target simultaneously hosting and operating mul communications, and electronic attack con unintentional interference sources to multi- broadcast assets, civilian radar assets, and In FY 2004: Evaluate multi-function radar electromagnetic compatibility issues assoc | orm techniques, ts. Determined t tiple radars, elec mponents on a si i-intelligence pla commercial con r sensing throug | knowledge-bas he electromagr tronic support ngle platform. tforms from th nmunications s h computer sin | sed scheduling, netic compatibi measure receiv Investigated n e ground and i ystems. nulations and e | , and advanced ility issues asso vers, integrated nethods to mitig n the air, such a emulations. Eva | target detection ciated with gate as commercial aluate the | I | 1.987 | 2.312 | 2.221 |
| Pro | oject 5017 | | • | | m No. 8-16 of 8-2 | | | | Exhibit R-2a (I | PE 0602204F) |
| | , | | | 152 | | | | | | |

| Exhibit R-2 | 2a, RDT&E Project Justification | DATE February 200 |)4 |
|---|--|----------------------|-----------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602204F Aerospace Sens | T NUMBER AND TITLE | ensors |
| simultaneously. Continue investigating methods to n such as commercial broadcast assets, civilian radar as multi-intelligence platforms. Initiate investigating el | c attack components on a single platform capable of operating nitigate unintentional interferers on the ground and in the air ssets, and commercial communications systems on ectronic counter-countermeasure techniques that will enable need jamming scenarios based upon multi-intelligence single | | |
| radio frequency (RF) processing techniques to minim hosting multiple radars, electronic support measure re attack components on a single platform capable of op unintentional interferers on the ground and in the air commercial communications systems on multi-intelli techniques that will enable maintaining a surveillance multi-intelligence single platform sensing. Initiate re | arough computer simulations and emulations. Laboratory test nize the electromagnetic compatibility issues associated with eceivers, integrated communications equipment, and electronic berating simultaneously. Evaluate methods to mitigate such as commercial broadcast assets, civilian radar assets, and gence platforms. Develop electronic counter-countermeasure e capability in various advanced jamming scenarios based upon esearch in advanced electronic counter countermeasures inveillance capability in various advanced jamming scenarios g. | | |
| (U) | | | |
| cruise missiles, slowly moving ground targets, and st (U) In FY 2003: Studied multi-mission adaptive radar all ground target detection, ground target imaging, electradvanced waveforms for achieving transmitter adapti interference rejection, self-protection, and target iden polarizations, modulations, and codings. Developed improved detection and false alarm control performance | | 3.052 | 1.899 |
| ground target detection, ground target imaging, and e achieving transmit adaptivity and simultaneous multi self-protection, and target identification by exploiting coding. Evaluate and refine knowledge-aided radar s alarm control performance in ground moving target in (U) In FY 2005: Evaluate multi-mission adaptive radar a ground target detection, ground target imaging, and e for achieving transmit adaptivity and simultaneous multi-mission adaptivity and simultaneous multi-mission adaptive radar and ground target detection. | g diversity in frequency, delay, polarization and modulation, and signal processing techniques for improved detection and false | | |
| Project 5017 | R-1 Shopping List - Item No. 8-17 of 8-27 | Exhibit R-2a (PE 06 | S02204E) |
| | 152 | | JUZZUHI J |

| Exhibit R-2a, RDT | &E Project Justification | DA | February | 2004 |
|--|---|-------|-----------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602204F Aerospace Sensors | | IMBER AND TITLE | R Sensors |
| coding. Laboratory test knowledge-aided radar signal processir control performance in multi-intelligence sensors.(U) | ng techniques for improved detection and false alarm | | | |
| (U) MAJOR THRUST: Study and analyze technology for detecting standoff aerospace platforms. | g and precisely locating concealed targets using | 0.530 | 0.781 | 2.211 |
| (U) In FY 2003: Initiated an investigation of emerging adaptive pro- multi-mission processing and resource management. Initiated the multi-mission conformal arrays. Initiated the study of wideband multi-function radar. | he study of adaptive processing techniques for | | | |
| (U) In FY 2004: Develop emerging adaptive processing techniques resource management. Study and analyze adaptive processing tech and analyze wideband and polarization adaptive processing tech distributed processing technology for next generation, deep-read | techniques for multi-mission conformal arrays. Study nniques for multi-function radar. Initiate investigating | | | |
| (U) In FY 2005: Evaluate emerging adaptive processing techniques resource management. Develop adaptive processing techniques evaluate wideband and polarization adaptive processing techniq distributed processing technology for next generation deep-reac | s for multi-mission conformal arrays. Develop and ues for multi-function radar. Continue investigating | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop wideband integrated photonic con(U) In FY 2003: Not Applicable. | nponents. | 0.000 | 0.000 | 0.353 |
| (U) In FY 2003: Not Applicable.(U) In FY 2004: Not Applicable. | | | | |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Initiate developing high-performance, low loss, wh | ideband integrated photonic link interconnect and | | | |
| switching components and subsystems for all weather space and This work is an outgrowth of other work in this project. | | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop wideband photonic analog-to-digi(U) In FY 2003: Not Applicable. | tal mixed signal conversion component technologies. | 0.000 | 0.000 | 0.271 |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Initiate developing high-resolution, ultra-fast, mul mixed signal conversion component technology for all weather systems. This work is an outgrowth of other work in this project. | space and airborne surveillance and reconnaissance | | | |
| (U) | | | | |
| (U) CONGRESSIONAL ADD: AFRL Information and Sensors Di | rectorate. | 1.277 | 0.000 | 0.000 |
| (U) In FY 2003: Tested and evaluated Global Positioning System re- encroachment by ultra-wideband devices. | eceivers to assess potential problems from spectrum | | | |
| Project 5017 | R-1 Shopping List - Item No. 8-18 of 8-27 | | Exhibit R-2a (F | PE 0602204F) |

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| | Exhibit R- | ·2a, RDT&E | Project Ju | stification | | | DATE | February 2004 |
|--|---------------------------------|----------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|--------------------------------|
| BUDGET ACTIVITY 02 Applied Research | | | | PE NUMBER A 0602204F A | ND TITLE erospace Sen | sors | PROJECT NUME | |
| (U) In FY 2004: Not Applicable.(U) In FY 2005: Not Applicable.(U) Total Cost | | | | | | | 7.400 | 6.643 7.362 |
| (U) <u>C. Other Program Funding Sun</u> | <u>ımary (\$ in Milli</u> | <u>ons)</u> | | | | | | |
| (U) Related Activities: PE 0602500F, (U) Multi-disciplinary Space Technology. | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> Estimate | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | Cost to Complete Total Cost |
| (U) PE 0603203F, Advanced Aerospace Sensors. (U) PE 0603270F, Electronic Combat Technology. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. | | | | | | | | |
| (U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | | | | | |
| Project 5017 | | | R-1 Shopping List | : - Item No. 8-19 of | 8-27 | | | Exhibit R-2a (PE 0602204F) |

| | Exh | | | | | | | | | |
|---------------------------------|---|---|--|--|---|--|---------------------|-----------------------------|------------------------------|-------------------------|
| | — /··· | ibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
| | ET ACTIVITY pplied Research | | | | E NUMBER AND | | ors | PROJECT NUME 6095 Sensor | BER AND TITLE Fusion Tech | nology |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| 6095 | Sensor Fusion Technology | 12.670 | 12.131 | 13.246 | 15.626 | 16.267 | 16.781 | 17.146 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | , î | | |
| space | In FY 2003, space unique tasks in this pro- unique activities. A. Mission Description and Budget Item This project develops the technologies req | <u>n Justification</u> | | | , | - | | | | |
| | recognition (ATR), integrated fire control, precisely locate, identify, and target airbor covert tactics for successful air-to-air and | and bomb dam ne and surface | age assessment targets. The provident of | t. This project | t determines the | feasibility of t | echnologies ar | d concepts for | fire control that | t help to |
| (U) N | B. Accomplishments/Planned Program (S AAJOR THRUST: Develop single and mu nd targeting mobile targets. | | and sensor fus | sion algorithms | s for rapidly find | ding, tracking, | | <u>2003</u> 3.789 | <u>FY 2004</u> 3.709 | <u>FY 2005</u> 1.614 |
| ra ti a a te ti | n FY 2003: Continued integrating and der apidly finding, tracking, and targeting mob ime-critical targets, on embedded high-per daptive resource allocation methods. Com nd targeting targets under trees (TUT). Co echnology, and multi-sensor and sensor fus neory research. Completed the first single | bile targets. Co formance comp tinued integrati ompleted develo sion assessmen sensor ATR pe | ntinued integra uting systems. ng and evaluat oping single se technology. (rformance prec | ting real-time Completed la ing algorithms nsor ATR perf Continued ATF diction model. | ATR algorithms boratory demor and concepts fo ormance assess R performance e | s, for astration of or detecting ment evaluation | | | | |
| ta h u a | n FY 2004: Evaluate single and multi-sensargeting mobile targets. Validate integratin igh-performance computing systems. Lab nder trees. Evaluate single sensor ATR per ssessment technology. Continue ATR per erformance prediction model. | ng real-time A7 oratory test alg erformance asse | TR algorithms for the second s | for time-critica incepts for dete logy, and mult | l targets on emb ecting and target i-sensor and ser | bedded ting targets asor fusion | | | | |
| (U) II F s c e s | n FY 2005: Develop improvement in image Research & Development (R&D) data colle ynthetic data generation tools to augment a omputer and networking infrastructure via ffectiveness of real-time ATR algorithms f ystems. Laboratory test multi-sensor and s | ections. Develo and enhance ex software, hard for time-critical | p automated in isting R&D and ware, and netw targets on emb sessment algorithms | nage analysis a d operational d vork integration bedded high-pe rithms. Contin | and truthing too lata sets. Impro- n enhancements erformance com- nue ATR performance | Is. Employ ve ATR R&D . Assess the puting mance | | | | |
| Proje | ct 6095 | | R-1 Sh | hopping List - Iter 156 | m No. 8-20 of 8-27 | 7 | | | Exhibit R-2a (I | PE 0602204F) |

| Exhibit R-2a, F | RDT&E Project Justification | DA | February | 2004 |
|--|---|-------|-----------------------------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602204F Aerospace Sensors | | IMBER AND TITLE or Fusion Tech | nology |
| evaluation theory research. Laboratory test the first multi-(U) | sensor ATR performance prediction model. | | | |
| (U) MAJOR THRUST: Develop, evaluate, and demonstrate ta recognition (ATR) and sensor fusion algorithm developme applications. | ent and testing for reconnaissance and strike mission | 3.798 | 3.891 | 6.429 |
| (U) In FY 2003: Developed target signature models for signat (EO) multi-spectral systems, and signals intelligence sense ground target signatures with sufficient fidelity to support mission environments. Developed modeling and simulation enhancements due to inserting ATR and sensor fusion aids time-critical targeting kill chain. | ors. Demonstrated the ability to generate synthetic air and automatic recognition of targets in operationally realistic on tools that can estimate warfighter effectiveness | | | |
| (U) In FY 2004: Laboratory test target signature models for si electro-optical multispectral systems, and signals intelligen signatures with sufficient fidelity to support automatic reco environments. Develop synthetic scene data generation ca development and operational data sets. Evaluate modeling effectiveness enhancements enabled by inserting ATR and components of the time-critical targeting kill chain. | nce sensors. Generate synthetic air and ground target ognition of targets in operationally realistic mission pability to augment and enhance existing research and g and simulation tools for estimating warfighter | | | |
| (U) In FY 2005: Evaluate target signature models for signatur and signals intelligence sensors. Continue to generate syn fidelity to support automatic recognition of targets in opera preliminary two-class ATR for EO sensed vibration of tact data generation capability applicable to large area reconnal | thetic air and ground target signatures with sufficient ationally realistic mission environments. Evaluate tical ground targets. Continue developing a synthetic scene issance coverage. Upgrade fidelity of modeling and ancements enabled by inserting ATR and sensor fusion aids | | | |
| (U) (U) MAJOR THRUST: Develop and demonstrate enabling A^T target detection, tracking, and identification in intelligence | ΓR, sensor management, and sensor fusion technologies for | 4.321 | 4.531 | 5.203 |
| identification (CID) applications. (U) In FY 2003: Completed evaluating adaptive learning techn demonstration of adaptive sensor management algorithms evaluating physics-based techniques for target detection ar | for target detection, tracking, and identification. Continued | | | |
| (U) In FY 2004: Exploit adaptive learning techniques for target exploitable radar features for target detection, tracking, and for target detection and identification for ISR and CID app | et identification using three-dimensional sensors. Study d identification. Laboratory test physics-based techniques | | | |
| Project 6095 | R-1 Shopping List - Item No. 8-21 of 8-27 | | Exhibit R-2a (I | PE 0602204F) |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | | DATE February | 2004 | |
|------------|--|---|---|--|---|---|----------------------------|----------------------|--|---------------|--|
| | GET ACTIVITY Applied Research | | | | | | | | PROJECT NUMBER AND TITLE 6095 Sensor Fusion Technolog | | |
| (U) | algorithms for detection and identify and deception. In FY 2005: Develop exploitable r demonstration of advanced algorith heavy camouflage, concealment, an time, position, attitude, and velocity time and distributed platform sensing along with other uncertainty reference | radar features for mus for detection and deception. Init y sensor data to en ng. Develop capa | arget detection, and identification iate technology nable improved ibilities to repre | tracking, and id on of targets und development th geo-location cap sent and utilizes | lentification. Co er trees and/or in at will capitalize pabilities for fut sensor parameter | ontinue laborator n the presence of e on precision ure distributed | | | | | |
| | MAJOR THRUST: Develop precisent environments. In FY 2003: Completed developing in hostile radio frequency environments | g Global Position | ing System-spe | cific jamming m | itigation technic | ues for operation | n | 0.762 | 0.000 | 0.000 | |
| (U) | Developed virtual flight test technol In FY 2004: Not Applicable. In FY 2005: Not Applicable. | | ••• | | • • | chilologies. | | 10 (70) | | 10.044 | |
| (U) (U) | Total Cost | | | | | | | 12.670 | 12.131 | 13.246 | |
| (0) | <u>C. Other Program Funding Sum</u> | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> Estimate | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> Estimate | <u>FY 2</u> Estir | | Total Cost | |
| | Related Activities: PE 0602500F, Multi-disciplinary Space | retuur | Listinute | <u>Estimate</u> | <u>Estimate</u> | Limate | <u>Estimate</u> | <u>L311</u> | | | |
| (U) | Technology. PE 0603203F, Advanced Aerospace Sensors. | | | | | | | | | | |
| (U) | PE 0602602F, Conventional Munitions. | | | | | | | | | | |
| (U) | PE 0603270F, Electronic Combat Technology. PE 0603226E, Experimental | | | | | | | | | | |
| | Evaluation of Major Innovative Technologies. | | | | | | | | | | |
| . , | PE 0603762E, Sensor and | | | | | 0.07 | | | | | |
| Pro | ject 6095 | | | R-1 Shopping List | - Item No. 8-22 of 8 158 | 8-27 | | | Exhibit R-2a | (PE 0602204F) | |

| | Exhibit | t R-2a, RDT&E Project Just | tification | DATE | ebruary 2004 |
|--------------------------------|---|----------------------------|---|----------------------------------|------------------------------|
| BUDGET / 02 Appli | ACTIVITY ied Research | | PE NUMBER AND TITLE 0602204F Aerospace Sensors | PROJECT NUMBER 6095 Sensor Fu | AND TITLE sion Technology |
| Gui This coo (U) Reli | Other Program Funding Summary (\$ in N dance Technology. s project has been rdinated through the iance process to harmonize orts and eliminate lication. | <u>Millions</u>) | | | |
| | Acquisition Strategy t Applicable. | | | | |
| Project 6 | 095 | R-1 Shopping List - | Item No. 8-23 of 8-27 | E | xhibit R-2a (PE 0602204F) |

| | Ext | nibit R-2a, I | RDT&E Pro | oject Justif | fication | | | DA | TE February | 2004 |
|---|---|--|--|--|---|---|--|---|---|---|
| | ET ACTIVITY oplied Research | | | | PE NUMBER AND 0602204F Aer | | ors | | UMBER AND TITLE Sensors & Coun | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | O Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | | L |
| 7622 | RF Sensors & Countermeasures Tech | 10.168 | 16.785 | 16.053 | | 25.258 | 23.269 | | | 0.000 |
| | Quantity of RDT&E Articles In FY 2003, efforts in radio frequency (R | 0 | 0 | 0 | ş | 0 | 0 | | 0 | |
| all spa | Also in FY 2003, space unique tasks in the ace unique activities. A. Mission Description and Budget Iter This project develops and assesses RF ser for fire control radar, electronic combat (I signatures that are difficult to detect due t develops the RF warning and countermea links and sensors of threat air defense systic increased capability for offensive and defense | n Justification using concepts f EC), and integra o reduced radar sure technology tems and hostile ensive RF senso | For aerospace a ated radar and be cross sections for advanced e command and | pplications thr EC systems. It concealment EC application d control netwo | ough modeling t emphasizes the and camouflage ns. Specifically, orks. The project | and simulation e detecting and e measures, sev , it develops tec ct also exploits | This project tracking of su ere clutter, or chniques and t emerging tecl ence application | also develop rface and air heavy jamm echnologies nnologies ano ons. | os and evaluates te borne targets with ing. This project a to detect and coun d components to p | chnology RF also ater the provide |
| (U) 1 s (U) 1 a t (U) 1 e f (U) 1 f (U) 1 f (U) 1 f (U) 1 f (U) 1 f (U) 1 s f (U) 1 s (U) 1 s f (U) 1 s (U) 1 (U) 1 | B. Accomplishments/Planned Program (MAJOR THRUST: Develop affordable RI survivability by degrading enemy radar, m in FY 2003: Developed multi-function EV advanced RF threats. Developed optimized hreat systems. Initiated phase calibration in FY 2004: Evaluate multi-function elect evaluations against new, advanced RF thre adar, communications, and missile threat s for a monopulse countermeasure technique in FY 2005: Develop a complex signal con- riendly advanced spread spectrum signals. Continue exploitation evaluations against r of phase calibration system for a monopuls | F jamming tech issile, and comm V technique way d EW technique development. ronic warfare (I ats. Continue d systems. Perfor to protect all A mmunication er Develop techniew, advanced I se countermeasu | mand and contriveforms. Contrest to degrade m EW) technique leveloping option im laboratory of the force platfor twironment simple and the force of the rest of the force of the force of the force of the force the force of the | rol systems. inued exploita nodern radar, c waveforms. C imized EW tec demonstration orms. nulator that con advanced digita aluate results co o protect all Ai | tion evaluations communications, Continue exploit hniques to degra of a phase calibu- ntains both adve al communication of a laboratory d ir Force platform | against new, and missile ation ade modern ration system rsary and ons jammer. emonstration | E | <u>Y 2003</u> 4.583 | <u>FY 2004</u> 5.036 | <u>FY 2005</u> 4.086 |
| (U) I | MAJOR THRUST: Develop technology to n FY 2003: Modeled threat identification state-of-the-art radar and EW digital receiv | algorithms for | next generation | n threat warnir | ng receivers. Ev | | | 1.649 | 2.064 | 1.268 |
| Proje | ect 7622 | | R-1 S | hopping List - Ite | em No. 8-24 of 8-2 | 7 | | | Exhibit R-2a | (PE 0602204F) |
| | | | | 16 | 0 | | | | | |

| Exhibit R-2a, RDT& | & E Project Justification | DA | February | 2004 |
|--|--|-------|-----------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602204F Aerospace Sensors | | IMBER AND TITLE | |
| components (analog-to-digital converters, filters, mixers, etc.) fo | | | | |
| advanced very high frequency receiver improvements for detecti (U) In FY 2004: Develop threat identification algorithms for next ge designing advanced very high frequency receiver improvements integrated tool suite in the modeling, simulation, design, and cha radio frequency (RF), microwave, etc.) component development Demonstrate breadboard electronic/photonic wideband digital received and the second /li> | eneration threat warning receivers. Continue for detecting targets under trees. Evaluate the tracterization environment for mixed-signal (digital, in advanced and emerging technologies. | | | |
| (U) In FY 2005: Validate threat identification algorithms for next ge affordable RF wideband RF cueing receiver technology. Evaluar microwave, etc.) and mixed-technology (electronics, micro-elect development using advanced and emerging technologies for digi | eneration threat warning receivers. Develop te the impact of mixed-signal (digital, RF, tro-mechanical, photonics, etc.) component | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop robust, ultra-widebandwidth anteni aerospace platform electronic apertures. | na technology for use in operational and future | 1.215 | 0.918 | 2.090 |
| (U) In FY 2003: Demonstrated breadboard wideband, high precisior antennas. Developed design tools to predict antenna performanc components and techniques that increase five-fold the signal han | e installed on host platform models. Demonstrated | | | |
| (U) In FY 2004: Evaluate breadboard wideband, high-precision inter Continue developing design tools to predict antenna performance to be a series that preside here each biotext is the series of a series of the | e installed on host platform models. Develop | | | |
| techniques that provide low-cost, lightweight phased arrays for le(U) In FY 2005: Develop and laboratory demonstrate advanced wide technology. Evaluate design tools to predict antenna performance | eband (3:1) transmit/receive (T/R) channel | | | |
| demonstrate techniques that provide low-cost, lightweight phased | d arrays for low band applications. | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop multi-function RF sensing concept | | 2.721 | 6.560 | 4.685 |
| (U) In FY 2003: Developed and evaluated innovative multi-function | • • • • • | | | |
| through modeling and simulation with an emphasis on system en | | | | |
| (U) In FY 2004: Develop and evaluate advanced multi-function and | • | | | |
| surveillance, and reconnaissance and targeting of time-critical tar advanced multi-intelligence sensor hardware and algorithms. De | | | | |
| coordination and synchronization techniques. | | | | |
| (U) In FY 2005: Model and simulate innovative multi-function RF s | • • • • • • | | | |
| Develop and evaluate advanced multi-function and multi-intellig | · · · · · · · · · · · · · · · · · · · | | | |
| reconnaissance and targeting of time-critical targets with applica | | | | |
| Project 7622 | R-1 Shopping List - Item No. 8-25 of 8-27 | | Exhibit R-2a (I | PE 0602204F) |

| | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | DATE | February | 2004 |
|---|--|--------------------------------------|--------------------------------------|-------------------------------------|-----------------------------------|---------------------|-----------------------------------|-----------------------------------|-------------------|
| BUDGET ACTIVITY 02 Applied Research | | | | PE NUMBER A 0602204F A | ND TITLE erospace Sen | isors | | BER AND TITLE | |
| aircraft. Initiate testbed planning requirements for advanced multi | | • • • • | validation of cor | cepts and the su | bsystem | | | | |
| (U) | interingence sensor | | | | | | | | |
| (U) MAJOR THRUST: Develop dig(U) In FY 2003: Not Applicable. | gital radio frequency | (RF) receiver/e | exciter technolog | y to support dig | ital beamformin | ıg. | 0.000 | 2.207 | 2.054 |
| (U) In FY 2004: Analyze and development of multiple channels, array calibration. Develop techninto aperture and signal processi | digital true time del | ay, channel equa | alization, distrib | ited waveform g | generation, and | | | | |
| (U) In FY 2005: Develop and evaluation power consumption, affordability the RF receiver, analog-to-digitation Perform testbed integration of magnetic statements | ate DBF-specific rec y using advanced di l conversion, digital | gital technologic channelization, | es, RF packaging and digital time | g, and functional delay beamstee | integration of ring subsystems | 5. | | | |
| (U) | | | , <u>F</u> | 8 Fe | | | | | |
| (U) MAJOR THRUST: Design expl | oratory outdoor tim | e transfer experi | iments between | multiple moving | platforms for | | 0.000 | 0.000 | 1.196 |
| enhanced situational awareness. | | | | | | | | | |
| (U) In FY 2003: Not Applicable. | | | | | | | | | |
| (U) In FY 2004: Not Applicable. | | | | | | | | | |
| (U) In FY 2005: Develop experiment centric warfare applications. | nts in assured referen | nce to evaluate a | dvanced naviga | tion technologie | s for network | | | | |
| (U) | | | | | | | | | |
| (U) MAJOR THRUST: Develop ad operation to improve interference frequency, delay, polarization, and (U) LEV 2002 Not A statistical | e rejection, self-prot | tection, and targ | | | | | 0.000 | 0.000 | 0.674 |
| (U) In FY 2003: Not Applicable. | | | | | | | | | |
| (U) In FY 2004: Not Applicable. | moooging to shrique | o for multi mice | ion conformal a | | | | | | |
| (U) In FY 2005: Develop adaptive p(U) Total Cost | brocessing technique | es for multi-miss | sion conformal a | rrays. | | | 10.168 | 16.785 | 16.053 |
| | | | | | | | 10.100 | 10.705 | 10.055 |
| (U) <u>C. Other Program Funding St</u> | | | | | | | | | |
| | FY 2003 Actual | <u>FY 2004</u> <u>Estimate</u> | FY 2005 Estimate | <u>FY 2006</u> Estimate | <u>FY 2007</u> <u>Estimate</u> | FY 2008 Estimate | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| (U) Related Activities: | <u> </u> | | | | | | <u></u> | <u></u> | |
| (U) PE 0602500F, | | | | | | | | | |
| Project 7622 | | F | R-1 Shopping List | Item No. 8-26 of 8 | 3-27 | | | Exhibit R-2a (| PF ()6()22()4F) |
| 110/0011022 | | I. | | 162 | | 1 | | | |

| Exhibit R-2a, | RDT&E Project Justification | DATE February 2004 | | | | |
|---|---|----------------------------|--|--|--|--|
| BUDGET ACTIVITY 02 Applied Research | | | | | | |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Multi-disciplinary Space Technology. (U) PE 0603203F, Advanced Aerospace Sensors. (U) Avionics Integration. PE 0603253F, Advanced Avionics Integration. PE 0602782A, Command, (U) Control, Communications Technology. (U) PE 0602232N, Navy C3 Technology. (U) PE 0603792N, Advanced Technology Transition. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | | | |
| Project 7622 | R-1 Shopping List - Item No. 8-27 of 8-27 | Exhibit R-2a (PE 0602204F) | | | | |

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PE NUMBER: 0602500F PE TITLE: MULTI-DISCIPLINARY SPACE TECH

| | Exhib | oit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 |
|--|------------------------------------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-------|
| BUDGET ACTIVITY PE NUMBER AND TITLE 02 Applied Research 0602500F MULTI-DISCIPLINARY SPACE TECH | | | | | | | | E TECH | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| | Total Program Element (PE) Cost | 95.779 | 101.360 | 84.581 | 81.118 | 101.359 | 123.236 | 122.071 | 0.000 | 0.000 |
| 5023 | Laser & Imaging Space Tech | 1.176 | 6.059 | 8.546 | 8.071 | 10.459 | 11.472 | 11.672 | 0.000 | 0.000 |
| 5024 | Human Centered Applied Space Tech | 0.475 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5025 | Space Materials Development | 17.625 | 19.447 | 21.499 | 20.797 | 26.531 | 36.390 | 35.919 | 0.000 | 0.000 |
| 5026 | Rocket Propulsion Component Tech | 22.410 | 51.909 | 40.961 | 42.123 | 44.413 | 45.360 | 46.357 | 0.000 | 0.000 |
| 5027 | High Speed Airbreathing Prop Tech | 4.014 | 4.549 | 0.180 | 0.250 | 0.255 | 0.260 | 0.264 | 0.000 | 0.000 |
| 5028 | Space Sensors, Photonics & RF Proc | 42.182 | 1.676 | 1.856 | 1.953 | 4.210 | 4.265 | 4.322 | 0.000 | 0.000 |
| 5029 | Space Sensor & CM Tech | 6.665 | 10.599 | 5.213 | 1.526 | 5.089 | 7.145 | 6.126 | 0.000 | 0.000 |
| 5030 | Applied Space Access Vehicle Tech | 1.232 | 0.000 | 0.000 | 0.000 | 3.907 | 8.246 | 7.321 | 0.000 | 0.000 |
| 5081 | Space Antennas Tech | 0.000 | 1.056 | 1.406 | 1.509 | 1.617 | 5.233 | 5.237 | 0.000 | 0.000 |
| 5082 | Optical Networking Tech | 0.000 | 6.065 | 4.920 | 4.889 | 4.878 | 4.865 | 4.853 | 0.000 | 0.000 |

Note: In FY 2003, this was a new PE, but not a New Start, resulting from the Space Commission recommendation to consolidate all space unique activities. In FY 2003, space unique efforts in the following PEs/Projects transferred to this PE in conjunction with the Space Commission recommendation: PE 0602102F, Projects 4347, 4348, 4349, and 5015, to Project 5025; PE 0602201F, Project 2403, to Project 5030; PE 0602202F, Project 7184, to Project 5024; PE 0602203F, Project 4847, to Project 5026; PE 0602203F, Project 3012, to Project 5027; PE 0602204F, Project 2002, to Project 5028; Projects 2002, 6095, and 7622, to Project 5029; PE 0602605F, Project 4866, to Project 5023. In FY 2004, efforts in Projects 5024 were terminated and efforts in Project 5030 were delayed until FY 2007 due to higher Air Force priorities. Also in FY 2004, space antenna efforts in PE 0602204F, Project 4916, were transferred to this PE, Project 5081, and the Air Force increased emphasis on developing optical networks for space-based applications in Project 5082. In addition, changes are due to adjustments based on recategorization of space unique tasks.

(U) A. Mission Description and Budget Item Justification

PE Description: This program advances the technology base in multiple disciplines for future space applications in eight projects, each focusing on a separate technology area including: 1) Laser and imaging space technologies develop concepts for advanced, very long-range optical systems and assess the vulnerability of satellites to the effects of high energy laser weapon systems. 2) Human centered applied space technologies focus on the human interface concepts that improve satellite operations during routine and on-demand space missions. 3) Space materials concentrate on the materials technology base for spacecraft and launch systems to improve affordability, maintainability, and performance. 4) Rocket propulsion component technologies advance technology in liquid propulsion rocket engines, solid rocket motors, spacecraft and upper stage propulsion, ballistic missiles, and application of advanced materials for rockets to achieve revolutionary launch capabilities. 5) High-speed airbreathing propulsion technologies develop advanced and combined cycle engine technologies for space sensor applications. 7) Space sensors and countermeasures technologies focus on generation, control, reception and processing of electronic signals for space sensor applications in intelligence, surveillance, reconnaissance, warning, electronic combat, and countermeasures. 8) Applied space access vehicle technologies develop advanced concepts for affordable on-demand access to space. 9) Lightweight satellite antenna technology and affordable antenna terminal technology for communications and surveillance. 10) Optical networking

R-1 Shopping List - Item No. 9-2 of 9-35

| | Exhibit R-2, RD1 | F&E Budget Item Justification | DATE Februa | ary 2004 |
|-----|---|--|------------------------------------|-------------------|
| | GET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY S | PACE TECH | • |
| | Congress added \$1.0 million for the Starfire Optical Rang Engine Test Site, and \$1.0 million for Photonics Technol | tions to provide the warfighter with unlimited communications to any ge Coating Facility, \$1.0 million for the Launch Vehicle Engine Proje logy. since it develops and determines the technical feasibility and military | ect, \$10.7 million for the Jet an | d Rocket |
| (U) | B. Program Change Summary (\$ in Millions) | | | |
| | | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| (U) | Previous President's Budget | 98.929 | 90.526 | 91.185 |
| (U) | Current PBR/President's Budget | 95.779 | 101.360 | 84.581 |
| (U) | Total Adjustments | -3.150 | 10.834 | |
| (U) | Congressional Program Reductions | | -2.000 | |
| | Congressional Rescissions | | -0.866 | |
| | Congressional Increases | | 13.700 | |
| | Reprogrammings | | | |
| | SBIR/STTR Transfer | -3.150 | | |
| (U) | Significant Program Changes: | | | |
| | • | Space Commission recommendation to consolidate all space unique | activities. In FY 2005, funding | reductions |
| | due to higher Air Force priorities. | | | |
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| | | R-1 Shopping List - Item No. 9-3 of 9-35 | - 1.1.1 | R-2 (PE 0602500F) |

| | Ext | nibit R-2a, F | RDT&E Pro | oject Justif | fication | | | DATE | February | 2004 |
|---|---|---|--|--|---|---|---------------|------------------------------|--------------------------------|-------------------------|
| | ET ACTIVITY oplied Research | | | | PE NUMBER AND 0602500F MUI SPACE TECH | | NARY | PROJECT NUMI 5023 Laser 8 | BER AND TITLE & Imaging Spa | ace Tech |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 5023 | Laser & Imaging Space Tech | 1.176 | 6.059 | 8.546 | | 10.459 | 11.472 | | 0.000 | 0.000 |
| | Quantity of RDT&E Articles In FY 2003, space unique efforts transfer | 0 | 0 | 0 | Ŷ | 0 | 0 | ů. | | |
| (U) | A. Mission Description and Budget Iten This project examines the technical feasib both imaging and beam projection applica space situational awareness mission. | n Justification | riented laser ar | nd imaging tec | hnologies/conce | pts including a | dvanced, very | long-range opt | | |
| (U) 1 2 3 4 3 4 3 4 4 3 4 4 3 4 3 4 3 4 3 4 3 | 3. Accomplishments/Planned Program (MAJOR THRUST: Develop advanced lon acquisition, tracking, and pointing; adaptiv coatings (low energy and high energy) that bower laser weapons as well as low power in FY 2003: Developed advanced long-rar projection and imaging applications. Developed advanced long-rar projection and imaging applications. Developed levelopment. Developed lightweight, low one-meter class ultra-light mirror with near in FY 2004: Develop technologies for light lifferent solutions for spacecraft and opticat in FY 2005: Develop critical optical techn levelopmental and field tests and ultimatel | g-range optical e optics; dual li support relay r imaging system nge optical tech loped technologeam stabilizatio power optics for final curvature atweight primar al control dynar ologies. Transi | ne of sight poin nirrors. Relay is. nologies such a gies such as bea n. Developed a or space-based and demonstra y mirrors appli nics. tion mature teo | nting; large, lig mirrors can gr as space-based am control; ac a roadmap for relay mirrors. ated correctior cable to bifoca | ghtweight optics reatly extend the relay mirrors to equisition, trackin relay mirror tech Produced and to n of the mirror so al relay mirrors. | ; and optical range of high support beam ng, and hnology ested urface. Investigate | ΕY | <u>7 2003</u> 0.589 | <u>FY 2004</u> 2.920 | <u>FY 2005</u> 6.433 |
| (U) N (U) I (U) I (U) I a | MAJOR THRUST: Assess the vulnerability update catalogued satellites. n FY 2003: Incorporated improved algori lata fusion workstations for the space situa n FY 2004: Develop finite state models for and provide a better estimate of on orbit sp n FY 2005: Update target system respons | thms and hardw ational awarenes or space system ace systems cap | vare for rapidly as mission. s that will enab abilities for in | v characterizing ble rapid chara nproved space | g new launches i cterization of ne situational awar | nto current w launches eness. | I | 0.587 | 2.139 | 2.113 |
| Proje | ct 5023 | | R-1 S | hopping List - Ite | em No. 9-4 of 9-35 | | | | Exhibit R-2a (I | PE 0602500F) |
| | | | | 16 | 7 | | | | | |

| D2 Applied Research and provide data to U.S. Sp | | | | | | | | | DATE February 2004 | | |
|--|--|---|--|--|--|-----------------------------------|-----------------------------------|-----------------------------------|--|--|--|
| | | | | | | | | | OJECT NUMBER AND TITLE 23 Laser & Imaging Space Tech | | |
| space systems that will enal systems capabilities for imp anchoring modeling tools to vulnerabilities and identify for rapidly characterizing sp assessments and for the spa | catalogued satellites. Enloyee apid characterization or oved space situational a pempirical data. Perform indicators of battle dama pace objects and new lau | nance and refine of new launche awareness. Upd n finite state mo ge assessment. nches into curre | finite state mod s and provide a ate lethality asse deling of laser ta Incorporate imp | leling process an better estimate of essment methodo argets to better u proved algorithm | d models for of on-orbit space ology by nderstand s and hardware | | | | | | |
| (U) (U) CONGRESSIONAL ADD: (U) In FY 2003: Not Applicable (U) In FY 2004: Develop a min with the capability to coat costripping, and vapor deposit coating room. | e. ror recoating chamber for other large mirrors as nee tion aluminum coating of | or the Starfire Op ded. Design and | ptical Range 3.5 d build the equip | ment needed for | r washing, | | 0.000 | 1.000 | 0.000 | | |
| (U) In FY 2005: Not Applicable(U) Total Cost | e. | | | | | | 1.176 | 6.059 | 8.546 | | |
| (U) <u>C. Other Program Fundi</u> | ng Summary (\$ in Milli | <u>ons)</u> | | | | | | | | | |
| (U) Related Activities: PE 0602605F, Directed En Technology. (U) PE 0603444F, Maui Space Surveillance Systems. PE 0603500F, (U) Multi-Disciplinary Adv De Space Technology. (U) PE 0603605F, Advanced Weapons Technology. This project has been (U) coordinated through the Reliance process to harmon | v | FY 2004 Estimate | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> | | |
| Project 5023 | | | R-1 Shoppina List | - Item No. 9-5 of 9 | -35 | | | Exhibit R-2a (| PE 0602500F) | | |

| UNCLASSIFIED | | | | | | |
|---|---|---|--|--|--|--|
| Exhibit R-2a, RDT&E | | DATE February 2004 PROJECT NUMBER AND TITLE | | | | |
| BUDGET ACTIVITY 02 Applied Research | Ch PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH | | | | | |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | | | | | |
| efforts and eliminate duplication. | | | | | | |
| U) D. Acquisition Strategy Not Applicable. | | | | | | |
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| Project 5023 | R-1 Shopping List - Item No. 9-6 of 9-35 169 | Exhibit R-2a (PE 0602500F | | | | |

| | ExI | nibit R-2a, I | RDT&E Pro | oject Justi | fication | | | DATE | February | 2004 |
|---|---|--|---|---|---|--|---|--|-------------------------|--------------|
| | ET ACTIVITY oplied Research | | | | PE NUMBER AND 0602500F MUI SPACE TECH | LTI-DISCIPLI | NARY | PROJECT NUME 5024 Human Tech | | plied Space |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 5024 | Human Centered Applied Space Tech | | 0.000 | 0.000 | | 0.000 | 0.000 | | 0.000 | 0.000 |
| Mater | Quantity of RDT&E Articles In FY 2003, space unique efforts transfer | 0 | 0 02202E Draia | 0 | Ű | 0 | 0 | 0 | | |
| all spa (U) (U) <u>E</u> (U) M (U) H n | A. Mission Description and Budget Iter This project identifies and develops huma awareness during routine and on-demand space battlespace, and lower cost for oper A. Accomplishments/Planned Program (MAJOR THRUST: Develop new crew int n FY 2003: Developed and evaluated new nix of human interface technologies that n n-orbit servicing, prepared a satellite cont | in this project we n Justification In and crew inter- space missions ations, training \$ in Millions) erface concepts worew interface maximize crew interface | erface concepts . Payoffs inclu , and moderniz s and identify n e concepts for s situational awa | due to higher and technolog de faster satel ation due to re whuman role satellite attack reness. Identi | Air Force priori gies that improve lite reconfigurat educed manning es for space oper reporting, havin fied new human | ities within the e satellite opera ion for time-cri and control sta rations. g the optimal roles for | Science and T ations, satellite itical targeting tion standardiz | echnology Prog attack reporting , improved situa | ram g, and crew situ | ational |
| (U) In (U) In | nulti-sensory control station interface usab n FY 2004: Not Applicable. n FY 2005: Not Applicable. Yotal Cost | ble across syste | ms. | | | | | 0.475 | 0.000 | 0.000 |
| È É | C <mark>. Other Program Funding Summary</mark> (S <u>FY</u> | 2003 F | | <u>FY 2005</u> Estimate | <u>FY 2006</u> <u>Estimate</u> | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total Cost |
| (U) H H T (U) H e | Related Activities: PE 0602202F, Human Effectiveness Applied Research. This project has been coordinated through the Reliance process to harmonize efforts and eliminate huplication. | | | | | | | | | |
| | D. Acquisition Strategy ct 5024 | | R-1 S | Shopping List - It 17 | em No. 9-7 of 9-35 | 5 | | | Exhibit R-2a (| PE 0602500F) |

| Exh | nibit R-2a, RDT&E Project Justification | DATE February 2004 | | |
|--|--|---|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH | PROJECT NUMBER AND TITLE 5024 Human Centered Applied Space Tech | | |
| Not Applicable. | | | | |
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| Project 5024 | R-1 Shopping List - Item No. 9-8 of 9-35 | Exhibit R-2a (PE 0602500F) | | |
| | 171 | | | |

| Ex | khibit R-2a, ∣ | RDT&E Pro | oject Justif | ication | | | | DATE | February | 2004 |
|--|--|---|--|---|--|---|--|--|--|----------------------------------|
| BUDGET ACTIVITY 02 Applied Research | | | c | PE NUMBER AND D602500F MUL SPACE TECH | | NARY | | | BER AND TITLE Materials Dev | elopment |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2 | 2009 | Cost to | Total |
| | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estir | | Complete | |
| 5025 Space Materials Development | 17.625 | 19.447 | 21.499 | 20.797 | 26.531 | 36.390 | | 35.919 | 0.000 | 0.000 |
| Quantity of RDT&E Articles Note: In FY 2003, space unique efforts were t | 0 | 0 | 0 | 0 | 0 | 0 | <u> </u> | 0 | | |
| (U) <u>A. Mission Description and Budget It</u> This project develops the materials and and future Air Force space systems. Fa nonmetallic composites, to provide new materials development in this project su materials are being developed that are a missile requirements. Materials technol ballistic missile applications. | em Justification processing techn milies of affordal capabilities for s pports the Integra ffordable, lightwo | ology base for ble lightweight spacecraft, ball ated High Payo eight, dimensio | spacecraft and materials are b istic missile, an off Rocket Prop onally stable, th | launch systems being developed, ad propulsion sy pulsion Technolo bermally conduc | to improve affe , including met stems to meet to ogy (IHPRPT) tive, and/or abl | ordability, mai als, polymers, he future spac Program. Adv ation and eros | intainabi ceramic e require vanced h ion resis | lity, and s, metal ements. igh-tem tant to 1 | d performance o llic composites, Rocket propul aperature protec meet space and | and sion tion ballistic |
| (U) <u>B. Accomplishments/Planned Program</u> (U) MAJOR THRUST: Develop materials a rocket propulsion systems. (U) In FY 2003: Evaluated new candidate m advanced organic composites for use in 1 environments. Identified and began eval valves, solid rocket casings, insulation, n databases and initiated demonstration of conditions for the intended rocket engine (U) In FY 2004: Develop candidate material characteristics for high-speed turbopump spacecraft propulsion. Evaluate high-ten articles with representative geometry to v nozzles, throats, and spacecraft propulsion to anticipate materials performance and r Identify new candidate materials suitable nozzles, and propellant catalysts. | ad processes to d aterials for rocke iquid oxygen, liq uating the applica ozzle throats, and suitability for app components. s and improve pr housings, ducts, perature metals, validate material on n. Establish mat nodel life-cycle to for spacecraft ar | t engines such uid hydrogen, l ations of these l spacecraft pro plication using ocessing capab valves, solid re ceramics, and characteristics erials database behavior of mat d rocket propu | as metal matrix high-temperatu materials to tur opulsion. Deve representative oilities to ensure ocket casings, i composite mat and processing and provide pr terials in a rock alsion environm | x composites, ce re, and high-pre- bopump housin eloped material p geometry and p e consistent mat insulation, nozzl erials by fabrica capabilities for redictive modeli tet propulsion en- | eramics, and essure gs, ducts, property rocessing erial le throats, and ting test solid rocket ng capability nvironment. rust chambers, | | <u>7 2003</u> 10.877 | | <u>FY 2004</u> 10.410 | <u>FY 2005</u> 11.176 |
| (U) In FY 2005: Evaluate materials in an app | | | • | | | | | | | |
| Project 5025 | | R-1 S | Shopping List - Ite | em No. 9-9 of 9-35 | | | | | Exhibit R-2a (F | というので、1602500F) |

| Exhibit R-2a, RDT& | E Project Justification | DA | DATE February 2004 | | |
|---|---|-------|-----------------------|--------------|--|
| BUDGET ACTIVITY 02 Applied Research | 02 Applied Research 0602500F MULTI-DISCIPLINARY SPACE TECH | | | | |
| solid rocket casings, insulation, nozzle throats, and spacecraft pro- representative geometry using high-temperature metals, ceramics, characteristics and processing capabilities for solid rocket nozzles engine component suitability using direct replacement of material material properties. Evaluate materials for pursuing applications catalysts at high-temperature, high-pressure and cryogenic environ | and composite materials to validate material , throats, and spacecraft propulsion. Evaluate s or enabling new design based on established such as thrust chambers, nozzles, and propellant | | | | |
| (U) (U) MAJOR THRUST: Develop nanostructured materials technology subsystems applications such as rocket engine components and cr | | 0.000 | 0.200 | 1.289 | |
| weights, better performance, and lower costs.(U) In FY 2003: Not Applicable. | | | | | |
| (U) In FY 2004: Investigate nanoparticle and nanostructured fabricati models for the efficient, low-cost assembly of nanomaterials. | | | | | |
| (U) In FY 2005: Develop nanoparticle and nanostructured fabrication models for the efficient, low-cost assembly of nanomaterials. | , characterization, processing techniques, and | | | | |
| (U) | | | | | |
| (U) MAJOR THRUST: Develop affordable, advanced structural and | non-structural materials and technologies for Air | 5.383 | 5.756 | 6.890 | |
| Force space applications. | | | | | |
| (U) In FY 2003: Optimized processing methods for the metallic mate | | | | | |
| high-strength components in future space vehicles. Tested non-au | | | | | |
| composite cryogenic tank structures for future Air Force space pla | | | | | |
| control coatings with controlled heat dissipation for spacecraft the | rmal control. Established baseline effects of the | | | | |
| space environment on polymer and thermal control coatings. | a that are appreciated to be used for lightweight | | | | |
| (U) In FY 2004: Mature processing methods for the metallic material high-strength components in future space vehicles. Develop and f | | | | | |
| gamma-titanium-aluminide technologies for reusable access to spa | • • | | | | |
| joining processes for large metallic cryotanks. Develop analytical | · · | | | | |
| liquid oxygen environments and in a simulated space environmen | | | | | |
| protection system concepts for high-Mach, reentry, and access to | | | | | |
| space thermal management applications. Integrate foams into hea | | | | | |
| high-temperature organic matrix composites for tanks and structure | | | | | |
| Fabricate laboratory-level demonstrations of optically tailorable a | ctive thermal control coatings with controlled heat | | | | |
| dissipation for spacecraft thermal control and three-fold increase i | n service life. Develop baseline effects of the space | | | | |
| environment on thermal control coatings, space lubricants, and oth | ner organic/inorganic space materials. Identify | | | | |
| Project 5025 | R-1 Shopping List - Item No. 9-10 of 9-35 | | Exhibit R-2a (F | PE 0602500F) | |

| Exhibit R | 2-2a, RDT&E Project Justification | DA | DATE February 2004 | | | |
|---|--|--------|---|---------------|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINAR SPACE TECH | | PROJECT NUMBER AND TITLE 5025 Space Materials Developmen | | | |
| | ic composites for standoff high temperature protection systems. e materials. Develop repair processes for non-metallic space | | | | | |
| gamma-titanium-aluminide as an external skin for r metallic cryotank materials for multiple mission acc liquid oxygen compatibility research. Continue to o Develop subscale novel high-temperature protection high-Mach vehicles flight profiles. Mature all-com oxidation-protected carbon-carbon materials. Estab coatings with controlled heat dissipation to provide Continue developing and evaluating baseline effect lubricants, and other organic/inorganic space mater temperature protection systems. Evaluate rapid insp | rature metallic high-temperature protection systems using reusable access to space vehicles. Assess aluminum-lithium cess to space. Expand experimental data and analytical results of derive a more representative test series for composite materials. on systems in conditions that simulate representative reentry and sposite heat-pipe radiators for Air Force space systems. Explore blish capability of optically tailorable active thermal control e three-fold increase in service life for spacecraft thermal control. ts of the space environment on thermal control coatings, space trials. Develop non-oxide ceramic composites for standoff high spection techniques for both advanced ceramic tile and standoff ess techniques to validate candidate space materials performance. tallic space materials | | | | | |
| (U) | als processing technologies to enable improved performance and | 1.365 | 3.081 | 2.144 | | |
| (U) In FY 2003: Refined improved thin film processing transitioned materials processing techniques and materialy radar and satellite-to-satellite data links. Demapplications capable of detecting very long waveler (U) In FY 2004: Identify higher performance materials advanced optical architecture in phased array radar wavelength, alternative infrared detector materials t (U) In FY 2005: Evaluate higher performance material | g techniques to optimize efficiency in solar cells. Validated and aterials that will enable high performance optical control of phased nonstrated alternative infrared detector materials for space ngths. s, including optical nanocomposites and exotic ferroelectronics, for and satellite-to-satellite data links. Scale-up very long to areas suitable for the fabrication of staring focal plane arrays. ls, including optical nanocomposites and exotic ferroelectronics, | | | | | |
| for advanced optical architecture in phased array ra performance of very long wavelength alternative m(U) Total Cost | ndar and satellite-to-satellite data links. Establish the detection naterials operating at 40°K. | 17.625 | 19.447 | 21.499 | | |
| Project 5025 | R-1 Shopping List - Item No. 9-11 of 9-35 | | Exhibit R-2a | (PE 0602500F) | | |

| UNCLASSIFIED | | | | | | |
|---|--|--|--|--|--|--|
| Exhibit R-2a, RDT& | E Project Justification | DATE February 2004 | | | | |
| BUDGET ACTIVITY D2 Applied Research | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH | PROJECT NUMBER AND TITLE 5025 Space Materials Developmen | | | | |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | | | | | |
| (U) D. Acquisition Strategy Not Applicable. | | | | | | |
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| Project 5025 | R-1 Shopping List - Item No. 9-12 of 9-35 | Exhibit R-2a (PE 0602500 | | | | |

| | Ext | nibit R-2a, I | RDT&E Pro | oject Justif | ication | | | | DATE | February | 2004 |
|-------|---|------------------------|------------------|--------------------|---|-------------------|----------------|-----------|-----------|-------------------------------|--------------|
| | ET ACTIVITY oplied Research | | | | PE NUMBER AND D602500F MUI SPACE TECH | | NARY | | | BER AND TITLE Propulsion C | component |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2 | 2009 | Cost to | Total |
| | · · · · | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estir | | Complete | |
| 5026 | 1 1 | 22.410 | 51.909 | 40.961 | 42.123 | 44.413 | 45.360 | | 46.357 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | |
| | In FY 2003, space unique efforts transfer | | • | | | • | - | | | | nsolidate |
| - | ace unique activities. In FY 2004, civilian | | rred from PE (|)602203F, Proj | ect 4847, into th | nis project in co | onjunction wit | h the Spa | ace Cor | nmission | |
| recom | mendation to consolidate all space unique | activities. | | | | | | | | | |
| | | | | | | | | | | | |
| (U) | A. Mission Description and Budget Iten | <u>n Justification</u> | | | | | | | | | |
| | This project develops advances in rocket j | propulsion tech | nologies for sp | ace access, spa | ace maneuver, a | nd ballistic mis | siles. Analyti | cal and e | experim | ental areas of e | mphasis |
| | are propellants, propellant management, c | combustion, roc | ket material ap | plications, Tec | hnology for Su | stainment of St | rategic System | ns (TSSS |) Phase | e 1, and novel sp | bace |
| | propulsion concepts. Technologies of inte | erest will impro | ve reliability, | performance, s | urvivability, aff | ordability, and | environmenta | l compat | ibility o | of future space a | and |
| | missile launch subsystems. Technologies | are developed | to reduce the v | veight and cost | of components | using new mat | erials and imp | roved de | esigns a | nd manufacturi | ng |
| | techniques. All efforts in this project cont | tribute to the In | tegrated High | Payoff Rocket | Propulsion Tecl | hnology (IHPR | PT) program, | a joint D | epartm | ent of Defense, | National |
| | Aeronautics and Space Administration, an | nd industry effo | rt to focus rocl | ket propulsion | technology on n | ational needs. | | | | | |
| an i | B. Accomplishments/Planned Program (| (\$ in Millions) | | | | | F | 7 2003 | | FY 2004 | FY 2005 |
| | MAJOR THRUST: Develop, characterize, | | ced hydrocarb | ons energetics | and reduced-to | oxicity | <u> </u> | 1.919 | | 2.670 | 3.363 |
| . , | nonopropellants to increase space launch | | • | | | • | | 1.717 | | 2.070 | 5.505 |
| | and test monopropellants with performance | • • | • | iew propenana | s synthesis mean | lous. Develop | | | | | |
| | in FY 2003: Scaled-up initial selected pro | - | | nonstrator engi | ine evaluations | Developed | | | | | |
| | high-energy-density oxidizers, nano-materi | - | - | - | | - | | | | | |
| | naterials into propellants with significantly | | | | - | - | | | | | |
| | nonopropellants towards reducing the cost | · • | | | • | | | | | | |
| | advanced combustion devices to determine | - | | | - | - | | | | | |
| | advanced propulsion concepts such as laser | | | | | • | | | | | |
| | in FY 2004: Continue scale-up of selected | | | - | | • | | | | | |
| | leveloping high-energy-density oxidizers, | | - | | - | | | | | | |
| | ncorporating these materials into propellar | | | | | | | | | | |
| | educed-toxicity ionic salt monopropellants | | | | | | | | | | |
| | Force applications. Begin development of | | - | - | | | | | | | |
| | of promising high energy-density materials | | | 1 1 | | 0 1 | | | | | |
| | combustion devices to determine materials | | | - | - | | | | | | |
| | propulsion concepts with enhanced perform | | - | | - | | | | | | |
| | | nance and rella | • | | • | | | | | | |
| Proje | ect 5026 | | R-1 S | hopping List - Ite | m No. 9-13 of 9-3 | 5 | | | | Exhibit R-2a (F | 2E 0602500F) |

| | Exhibit R-2a, RDT&E Project Jus | tification | DA | February 2 | 2004 |
|-----|---|---|---------------------------------|-----------------|-------------|
| | GET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH | PROJECT NU 5026 Rock Tech | omponent | |
| | combined cycle engines. Formulated propellant ingredients for IHPRPT-Phase III see begin transition to propellant formulation. | | | | |
| (U) | In FY 2005: Continue scale-up of selected propellants for laboratory and demonstra developing high-energy-density oxidizers, nano-materials, and polymeric binders (i. compounds) and optimize paths for incorporating these materials into propellants wi performance. Continue evaluating reduced-toxicity ionic salt monopropellants towa access and space operations. Continue development of advanced catalysts for new r Continue scaling-up of promising high energy-density materials candidates. Continue in advanced combustion devices to determine materials compatibility and performant analyze advanced propulsion concepts with enhanced performance and reliability su and rocket-based combined cycle engines. Continue maturing solid propellants ingr | e., linked heterocyclic th significantly enhanced rds reducing the cost of space nonopropellant formulations. ue to evaluate selected propellants ice. Continue to model and ch as laser-propelled lightcraft | | | |
| ДD | formulations. | | | | |
| | MAJOR THRUST: Develop advanced liquid engine combustion technology for imp preserving chamber lifetime and reliability needs for engine uses in heavy lift space | vehicles. | 0.938 | 4.445 | 7.512 |
| (U) | In FY 2003: Characterized, studied, and evaluated specific injector performance to compatibility and prevent damage to test and operational combustion devices. Deve advanced combustion devices and injectors compatible with new energetic propellar advanced propulsion concepts, such as rocket-based combined cycle engines and put enhanced performance and reliability. | loped, analyzed, and modeled its. Modeled and analyzed | | | |
| (U) | In FY 2004: Continue to characterize, study, and evaluate injector performance to e compatibility and prevent damage to test and operational combustion devices. Continued advanced combustion devices and injectors compatible with new energetic presting to characterize causes and issues that lead to combustion instability in hydroc engines reducing the need for conducting large numbers of costly full-scale compone begin transitioning advanced hydrocarbon fuels for scale-up and testing. Continue m propulsion concepts with enhanced performance and reliability such as common aero systems. | nue to develop, analyze, and opellants. Begin analyzing and carbon fueled liquid rocket ent and engine tests. Develop and nodeling and analyzing advanced | | | |
| (U) | In FY 2005: Continue to characterize, study, and evaluate injector performance to e compatibility and prevent damage to test and operational combustion devices. Continued advanced combustion devices and injectors compatible with new energetic presting to characterize causes and issues that lead to combustion instability in hydroc engines reducing the need for conducting large numbers of costly full-scale component working on transition issues, testing, scale-up of advanced hydrocarbon fuels. Continue to combustion fuels. | nue to develop, analyze, and opellants. Continue analysis and earbon fueled liquid rocket ent and engine tests. Continue | | | |
| Pro | oject 5026 R-1 Shopping List - | Item No. 9-14 of 9-35 | | Exhibit R-2a (P | E 0602500F) |

| | Exhibit R-2a, RDT&E Project Ju | ustification | DA | [™] February | 2004 |
|-----|--|--|-------|-----------------------------------|--------------|
| | OGET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH | | MBER AND TITLE et Propulsion C | component |
| | advanced propulsion concepts with enhanced performance and reliability such as a launch systems. | common aerovehicles and potential | | | |
| (U) | | | | | |
| | MAJOR THRUST: Develop advanced material applications for lightweight comp enhancements for use in rocket propulsion systems. | oonents and material property | 2.579 | 3.014 | 3.884 |
| (U) | In FY 2003: Developed advanced ablative components with hybrid polymers for a systems. Characterized and developed new high temperature polymer components use in advanced combustion devices and propulsion systems to meet lower weight requirements. Developed advanced motor casings and propellant system components. | s and carbon-carbon components for , increased strength, and lower cost | | | |
| (U) | In FY 2004: Continue additional developing advanced ablative components with 1 and future launch systems. Continue to characterize and develop new processes for carbon-carbon materials for use in advanced combustion devices and propulsion sy increased strength requirements. Continue developing advanced material compon propellants. Commence transition of advanced high temperature material compon cost, and increase performance. Initiate exploration of the use of nanocomposites | hybrid polymers for use in current or high temperature polymers and ystems to meet lower weight and ents for use with high-energy ents to reduce system weight and | | | |
| (U) | In FY 2005: Continue developing advanced ablative components using hybrid po- launch systems. Continue to characterize and develop new high temperature polyt for use in advanced combustion devices and propulsion systems to meet lower wei requirements. Continue developing advanced materials for use with high-energy p specific advanced high temperature materials to air and space systems to reduce sy performance. Continue to explore using nanocomposites for liquid rocket engine | mers and carbon-carbon materials ight and increased strength propellants. Complete transition of ystem weight and cost, and increase | | | |
| (U) | I I I I I I I I I I I I I I I I I I I | | | | |
| (U) | MAJOR THRUST: Develop propulsion component technologies for reliable, safe In FY 2005, these activities will be moved to the "advanced liquid engine technologies" | - | 5.079 | 1.386 | 0.000 |
| (U) | In FY 2003: Completed development and began testing single stage hydrogen tur engines. Developed components for hybrid propulsion technologies for space boo Tested preliminary injector for hydrocarbon or cryogenic fuel applications. | | | | |
| (U) | In FY 2004: Complete testing of single stage hydrogen turbopump for advanced c development of components for hybrid propulsion technologies for space boosters Continue hydrocarbon fuel characterization test rig development and evaluation of | and air launched missiles. | | | |
| (U) | In FY 2005: Not Applicable. | 1 2 | | | |
| (U) | | | | | |
| (U) | MAJOR THRUST: Develop lightweight combustion devices and nozzle technolo Note: In FY 2004, the funding in this activity increased due to salary funds being | | 3.091 | 23.476 | 0.000 |
| Pr | oject 5026 R-1 Shopping Lis | st - Item No. 9-15 of 9-35 | | Exhibit R-2a (F | PE 0602500F) |
| | | 178 | | | |

| Exhibit R-2a, RDT&E Proje | DATE February 2004 | | | |
|--|--|-------|----------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PROJECT NUMBER AND TITLE 5026 Rocket Propulsion Componen Tech | | | |
| Project 4847 and the reprioritization of efforts. In FY 2005, these activities engine technologies" effort in this Project. (U) In FY 2003: Developed advanced lightweight rocket engine nozzle for upp Completed preliminary study for high-pressure turbopumps for use in advar (U) In FY 2004: Continue development of an advanced lightweight altitude-co studies for advanced liquid oxygen and liquid hydrogen turbopumps for the engines. (U) In FY 2005: Not Applicable. (U) | ber stage and space booster applications. nced upper stage engines. mpensating nozzle. Continue design | | | |
| (U) MAJOR THRUST: Develop advanced liquid engine technologies for impr reliability needs for engine uses in expendable and reusable launch vehicles were conducted under other efforts earlier in this Project. | | 0.000 | 0.000 | 21.031 |
| (U) In FY 2003: Not Applicable. | | | | |
| (U) In FY 2004: Not Applicable. | | | | |
| (U) In FY 2005: Continue development of advanced cryogenic upper stage tech and modeling tools. Continue hydrocarbon fuel characterization test rig de hydrocarbon fuels. Complete development of lightweight nozzle for liquid developments for future reusable hydrocarbon based engines. | velopment and evaluation of potential | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop missile propulsion, aging, and surveillance ter Intercontinental Ballistic Missile (ICBM) to include testing of missile propulsions Systems (PBCS). Efforts support Technology for Sustainment of Strategic FY 2004, the efforts in this activity will be moved to the Advanced Techno Project 5033. | ulsion technology and Post Boost Control 2 Systems program - Phase I. Note: After | 2.383 | 0.500 | 0.000 |
| (U) In FY 2003: Integrated aging models results and testing a database for agin fleet. Completed tools to increase the capability to determine the service life rocket motors. Prepared components for demonstrations of advanced lighty development of components for demonstrations of advanced full-scale, flig | fe of strategic systems and other solid weight solid rocket motors. Commenced | | | |
| (U) In FY 2004: Continue development and fabrication of components for dem like PBCS. | nonstrations of advanced full-scale, flight | | | |
| (U) In FY 2005: Not Applicable. | | | | |
| (U) (I) MAJOR THENET. Develop color electric color thermal chamical and ad | | 2.462 | 4.017 | E 171 |
| (U) MAJOR THRUST: Develop solar electric, solar thermal, chemical, and ad stationkeeping, repositioning, and orbit transfer for large communication sa | | 2.463 | 4.817 | 5.171 |
| | pping List - Item No. 9-16 of 9-35 | | Exhibit D 00 (| PE 0602500F) |
| Project 5026 R-1 Shop | 179 | | | |

| Exhibit R-2a, RDT&E Project | Justification | DA | February | 2004 |
|---|--|---------------------------------|-----------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH | PROJECT NU 5026 Rock Tech | component | |
| constellations. Phases are referring to the Integrated High Payoff Rocket Prop (U) In FY 2003: Advanced small-scale Hall thruster development efforts to achieve electric propulsion. Enhanced development of microsatellites propulsion system advanced imaging missions. Developed solar thrusters and concentrators for f controlled solid propellant. Completed development of high power solar there. | ve Air Force orbit transfers using ems (e.g., plasma thrusters) for uture orbital transfer vehicles. Tested a | | | |
| (U) In FY 2004: Commence development of monopropellant thruster component propulsion - catalyst. Continue Hall thruster development efforts (Phase III) to electric propulsion. Continue development of microsatellites propulsion syste imaging missions. Continue developing solar thrusters and concentrators for f Continue testing of a controlled solid propellant. | o achieve Air Force orbit transfers using ms (e.g., plasma thrusters) for advanced | | | |
| (U) In FY 2005: Continue development of monopropellant thruster component teapropulsion - catalyst and thrust chamber. Continue Hall thruster development orbit transfers using electric propulsion. Continue this phase of development of (e.g., plasma thrusters) for advanced imaging missions. Continue developing future orbital transfer vehicles. Continue testing of a controlled solid propella (U) | efforts (Phase III) to achieve Air Force of microsatellites propulsion systems solar thrusters and concentrators for | | | |
| (U) CONGRESSIONAL ADD: Engineering Tool Improvement Program (ETIP). (U) In FY 2003: Assessed and verified tool performance for additional data require tool against available data. Made recommendations for future modeling and d contribute to the ongoing development of modeling and simulation tools to an aerospace engines and their components. Improved analytical tools associated focus on high performance, long life, advanced cooling techniques, and combuted to the contribute of the contribute of the contribute of the performance of the contribute /li> | ata acquisition. These efforts will alyze and predict the performance of with aerospace engines with the main | 1.979 | 0.000 | 0.000 |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. (U) | | | | |
| (U) CONGRESSIONAL ADD: Integrated High Payoff Rocket Propulsion Technol (U) In FY 2003: Developed propellant formulations for space lift applications. Consider the liquid boost engine development. | | 1.979 | 0.000 | 0.000 |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. (U) | | | | |
| (U) CONGRESSIONAL ADD: Launch Vehicles Engine Project. (U) In FY 2003: Not Applicable. (U) In FY 2004: Conduct studies and develop hardware for proof of concept for a | low cost launch vehicle engine with | 0.000 | 0.992 | 0.000 |
| Project 5026 R-1 Shoppin | g List - Item No. 9-17 of 9-35 | | Exhibit R-2a (F | PE 0602500F) |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DAT | E February | 2004 |
|---|--|--|--------------------------------------|------------------------------------|-----------------------------------|----------------------------|---|-----------------------------------|---------------|
| 02 Applied Research 00 | | | | | ND TITLE IULTI-DISCIPL CH | INARY | PROJECT NUMBER AND TITLE 5026 Rocket Propulsion Componen Tech | | |
| 400,000 pound of thrust using liquid space a potential alternative upper sta defined in a Space Systems Loral stu (U) In FY 2005: Not Applicable. (U) | age engine and a dy in FY 2002 | as the main engi under the Califo | ne for a low-cos rnia State Space | st consumables b Grant program. | booster that was | | | 10.000 | |
| (U) CONGRESSIONAL ADD: Jet and I 2003 Congressional Add in PE 0602. (U) In FY 2003: Not Applicable. (U) In FY 2004: Continue further upgrad Bernardino. Expand testing to include (U) In FY 2005: Not Applicable. | 203F, Project 4 | 847. t engine test star | nds at the forme | r Norton Air For | | | 0.000 | 10.609 | 0.000 |
| (U) Total Cost | | | | | | | 22.410 | 51.909 | 40.961 |
| (U) <u>C. Other Program Funding Summ</u> | t <mark>ary (\$ in Milli</mark> <u>FY 2003</u> <u>Actual</u> | <u>ons)</u> <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> Estimate | FY 2009 Estimate | <u>Cost to</u> <u>Complete</u> | Total Cost |
| (U) Related Activities: PE 0601102F, Defense Research Sciences. | | | | | | | | | |
| (U) PE 0602114N, Power Projection Applied Research. PE 0602203F, Aerospace | | | | | | | | | |
| (U) Propulsion. (U) PE 0602303A, Missile Technology. | | | | | | | | | |
| (U) PE 0602805F, Dual Use Science and Technology. PE 0603216F, Aerospace | | | | | | | | | |
| (U) Propulsion and Power Technology. PE 0603500F, | | | | | | | | | |
| (U) Multi-Disciplinary Adv Dev Space Technology. (U) This project has been | | | | | | | | | |
| Project 5026 | | F | | - Item No. 9-18 of 9 | 9-35 | | | Exhibit R-2a | (PE 0602500F) |

| Exhibit R-2a, RDT&E P | DATE February 2004 | | | |
|---|---|----------------------------|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE PRO- 0602500F MULTI-DISCIPLINARY 5020 SPACE TECH Tech | | | |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> coordinated through the Reliance process to harmonize efforts and eliminate duplication. | | | | |
| (U) D. Acquisition Strategy Not Applicable. | | | | |
| Project 5026 R-1 | Shopping List - Item No. 9-19 of 9-35 | Exhibit R-2a (PE 0602500F) | | |

| ExI | nibit R-2a, I | RDT&E Pro | oject Justi | fication | | | | DATE | February | 2004 |
|--|--|--|--|--|---|--|---------------------------------|-----------------------------------|---|-----------------------|
| BUDGET ACTIVITY 02 Applied Research | | | | PE NUMBER AND 0602500F MUI SPACE TECH | LTI-DISCIPLI | NARY | | | BER AND TITLE Beed Airbreat | hing Prop |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2 | 2009 | Cost to | Total |
| | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estir | nate | Complete | |
| 5027 High Speed Airbreathing Prop Tech | 4.014 | 4.549 | 0.180 | | 0.255 | 0.260 | | 0.264 | 0.000 | 0.000 |
| Quantity of RDT&E Articles | 0 | 0 | 0 | Ů | 0 | 0 | | 0 | | |
| Note: In FY 2003, space unique efforts transfer all space unique activities. (U) <u>A. Mission Description and Budget Iter</u> This project develops revolutionary, airbr short-term focus is on hydrocarbon fueled scramjet powered engines that can enable to both the Department of Defense and th | n Justification eathing, hypers engines capab the higher Mac | onic propulsion le of operating th numbers to a | n technology o over a broad r achieve access | options to enable range of flight M to space. Tech | affordable, on lach numbers a nologies develo | demand acces nd longer term ped under this | s to spac focus w progran | ce for the or vill be on n enable | e Air Force. Tl n hydrogen fuel e capabilities of | ne led interest |
| components, advanced component develo (U) <u>B. Accomplishments/Planned Program (</u> (U) MAJOR THRUST: Conduct studies and d | pment, and gro <u>\$ in Millions</u>) evelop hyperso | und-based tests | s. | le concepts. No | ote: In FY 2004 | <u>F</u> Y | <u>7 2003</u> | | <u>FY 2004</u> | <u>FY 2005</u> |
| these activities were moved to PE 0602203 (U) In FY 2003: Developed preliminary flight integration of hydrocarbon fueled scramjet (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. (U) | demonstrator v | | • | | | | 0.223 | | 0.000 | 0.000 |
| (U) MAJOR THRUST: Conduct assessments, (CCEs) and advanced cycle airbreathing hy affordable, on-demand access to space veh (U) In FY 2003: Conducted assessment of adv limits enabling development of low interna (U) In FY 2004: Continue to conduct system t technology goals. Define component and o hypersonic CCEs. (U) In FY 2005: Conduct system trade studies Continue to define component and engine | ypersonic propu icles to meet fu anced airbreath I drag scramjet rade studies to engine performa- to determine m | ilsion technolog ture warfighter ing engines an flowpath for ra determine milit ance objectives | gies in support needs. d CCEs to esta eusable applica ary payoff and to enable dev nd establish co | t of the developr ablish and extend ations. d establish comp elopment of affo omponent techno | nent of d operability ponent prdable plogy goals. | | 0.288 | | 0.568 | 0.180 |
| CCEs. | | | | | | | | | | |
| (U) | | | | | | | | | | |
| Project 5027 | | R-1 SI | hopping List - Ite | em No. 9-20 of 9-3 | 5 | | | | Exhibit R-2a (F | PE 0602500F) |
| | | | 18 | 0 | | | | | | |

| | JMBER AND TITLE Speed Airbreathin 0.000 | ng Prop 0.000 |
|--|---|------------------|
| hypersonics to meet future warfighter needs and to support flight demonstration. Note: In FY 2004, these activities were split with non-access to space activities moving to PE 0602203F, Project 3012 and access to space activities moving to the "robust hydrocarbon fueled scramjet" effort in this Project. (U) In FY 2003: Conducted initial feasibility assessment of variable geometry devices to increase scramjet operating range (Mach 3 to Mach 8+) to provide robust options for combined cycle engines. (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. | | 0.000 |
| | | |
| (U) MAJOR THRUST: Develop robust hydrocarbon fueled scramjet engine components and technologies and integrate 2.557 them into advanced combined cycle engine (CCE) designs for affordable, on-demand access to space vehicles. Note: 1 In FY 2005, these activities will be moved to PE 0602203F, Project 3012 to consolidate all 6.2 scramjet development efforts. 2 | 3.981 | 0.000 |
| (U) In FY 2003: Developed initial critical components for advanced airbreathing engines and CCEs for robust performance over extended Mach range to include efforts to improve scramjet engine operability and scalability. Initiated development of high performance/low internal drag devices. | | |
| (U) In FY 2004: Complete initial feasibility assessments of variable geometry devices to increase scramjet operating range (Mach 3 to Mach 8+) to provide robust options for CCEs. Continue development of advanced engine components to improve operability, scalability, and structural durability for reusable applications. Continue developing and demonstrating low internal drag flame stabilization devices. Demonstrate advanced ignition systems for scramjets. Conduct assessment of current structural concepts and identify life-limiting factors and initiate development of multi-use components. Initiate the support for development of flight test engine components | | |
| (U) In FY 2005: Not Applicable.(U) Total Cost4.014 | 4.549 | 0.180 |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> <u>FY 2003 FY 2004 FY 2005 FY 2006 FY 2007 FY 2008 FY 2009</u> <u>Actual Estimate Estimate Estimate Estimate Estimate Estimate</u> | 10 | <u>otal Cost</u> |
| Image: Contract Pointage Image: Contract Pointage (U) Related Activities: (U) PE 0601102F, Defense Research Sciences. (U) PE 0602201F, Aerospace Flight Dynamics. (U) PE 0602203F, Aerospace | | |
| Project 5027 R-1 Shopping List - Item No. 9-21 of 9-35 184 | Exhibit R-2a (PE 0 | 0602500F) |

| Exhibit R-2a, RD | DATE February 2004 | | | |
|--|---|--|----------------------------|--|
| BUDGET ACTIVITY 02 Applied Research | | | | |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | | | |
| Propulsion. | | | | |
| (U) PE 0602602F, Conventional | | | | |
| Munitions. | | | | |
| (U) PE 0602702E, Tactical | | | | |
| Technology. | | | | |
| (U) PE 0603111F, Aerospace | | | | |
| Structures. | | | | |
| PE 0603216F, Aerospace | | | | |
| (U) Propulsion and Power | | | | |
| Technology. | | | | |
| (U) PE 0603601F, Conventional | | | | |
| Weapons Technology. Program is reported | | | | |
| to/coordinated by the Joint | | | | |
| (U) Army/Navy/NASA/Air Force | | | | |
| (JANNAF) Executive | | | | |
| Committee. | | | | |
| This project has been | | | | |
| coordinated through the | | | | |
| (U) Reliance process to harmonize | | | | |
| efforts and eliminate | | | | |
| duplication. | | | | |
| - | | | | |
| (U) <u>D. Acquisition Strategy</u> | | | | |
| Not Applicable. | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Project 5027 | R-1 Shopping List - Item No. 9-22 of 9-35 | | Exhibit R-2a (PE 0602500F) | |

| | Ext | nibit R-2a, I | RDT&E Pro | oject Justi | fication | | | DATE | February | 2004 |
|--|---|---|---|--|---|---|--|--|---|-------------------------|
| | ET ACTIVITY oplied Research | | | | PE NUMBER AND 0602500F MUI SPACE TECH | LTI-DISCIPLI | NARY | PROJECT NUMBER AND TITLE 5028 Space Sensors, Photonics & RF Proc | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ in Millions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 5028 | Space Sensors, Photonics & RF Proc | 42.182 | 1.676 | 1.856 | 5 1.953 | 4.210 | 4.265 | 4.322 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | C | * | 0 | 0 | ÷ | | |
| all spa (U) | In FY 2003, space unique efforts transfer ace unique activities. A. Mission Description and Budget Iter This project focuses on developing metho radio frequency (RF) space sensor applica engagement sensors based in space. The dissipation, higher reliability, and improve affordable and reliable space surveillance | n Justification ds of generatin ations. The ena project aims to ed performance | g, controlling, 1 bling technolog demonstrate sig . This project | receiving, trar gies will be us gnificantly im | asmitting, and proved for intelligence | ocessing photo ce, surveillance space sensors c | nic, optical, ar e, reconnaissar f smaller size, | nd opto-electron nce, electronic v , lower weight, 2 | ic (mixed) sign varfare, and pre lower cost, lowe | als for cision |
| (U) M (U) I s (U) I s (U) I (U) I c | B. Accomplishments/Planned Program (MAJOR THRUST: Design and develop hi in FY 2003: Designed and developed high witching components and subsystems for ate space sensors and communication syst in FY 2004: Fabricate and evaluate high p witching components and subsystems for and for high data rate space sensors and co in FY 2005: Test and evaluate high perfor components and subsystems for wideband data rate space sensors and communication | igh performance a performance in wideband RF p ems. erformance inte wideband radio mmunication sy mance integrate radio frequency | ntegrated photo hased array and egrated photoni o frequency pha ystems ed photonic tec | onic technolog tenna beamfor ic technology ased array ante hnology link, | y link, interconn rming/control, ar link, interconnec enna beamformir interconnect, and | ect, and nd for high data et, and ng and control, d switching | | <u>Y 2003</u> 0.351 | <u>FY 2004</u> 0.574 | <u>FY 2005</u> 0.250 |
| (U) (U) M (U) I (U) I (U) I | MAJOR THRUST: Design and develop ef in FY 2003: Designed and developed effic- signal component subsystems. In FY 2004: Fabricate, test, and evaluate e nixed signal component subsystems. In FY 2005: Test and evaluate efficient, his component subsystems. | fficient, high co cient, high coeff fficient, high co | ficient chip-sca | le optical way | veguide technolo | gy for mixed ology for | | 0.191 | 0.242 | 0.335 |
| | oct 5028 | | R-1 C | honning List - It | em No. 9-23 of 9-3 | 5 | | | Exhibit R-2a (| PE (1602500E) |
| iioje | | | 11-1 0 | | | <u> </u> | | | | |

| Exhibit R-2a, RDT&E P | roject Justification | DA | TE February | 2004 | |
|--|---|--------|---|--------------|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH | | NUMBER AND TITLE ace Sensors, Photonics & RF | | |
| (U) MAJOR THRUST: Perform independent modeling, test, and evaluation (U) In FY 2003: Performed independent modeling, test, and evaluation for integrated electro-optical devices for space-based sensors. (U) In FY 2004: Apply the results of modeling, test, and evaluation for space-based electro-optical devices for space-based sensors to component integrated electro-optical devices for space-based sensors to component and communication systems. (U) In FY 2005: Design and develop photonic digital and analog mixed signal for high data rate space sensors and communication systems. | r space-qualified photonic components and ace-qualified photonic components and nt architectures for high data rate space sensors | 0.333 | 0.242 | 0.183 | |
| (U) (U) MAJOR THRUST: Study adaptive processing techniques for large, m (U) In FY 2003: Studied adaptive processing techniques for large, multi-n (U) In FY 2004: Continue to study and analyze adaptive processing technia adaptive conformal arrays. (U) In FY 2005: Develop adaptive processing techniques suitable for implanchitectures for multi-intelligence ISR sensing from space-based platf | nission, space-based conformal arrays. iques for large, multi-mission, space-based, lementation on space-qualified computing | 0.096 | 0.618 | 1.088 | |
| (U) (U) CONGRESSIONAL ADD: Defense Emergency Response Fund (DEFAirborne Moving Target Indication Research (U) In FY 2003: Developed a system brassboard of the Active Electronic S (AESA/OBP) to demonstrate the technology readiness of the most critic Radar. Developed the processing architecture, adaptive signal process resistant processing for OBP in a space environment. Developed Battl Communications techniques for multiple satellite tasking, target tracking and validated Space-Based Radar and Moving Target Exploitation sim tool for both short term acquisition and longer term capability enhance Moving Target Indication and Airborne Moving Target Indication procedutter and interference. (U) In FY 2004: Not Applicable. | Scanned Antenna and On-Board Processor ical element of an affordable Space-Based sing algorithms, and fault tolerant, radiation le-Management Command, Control and ng, and moving target exploitation. Refined sulation capabilities to serve as a development ement. Developed and validated both Ground | 41.211 | 0.000 | 0.000 | |
| (U) In FY 2005: Not Applicable.(U) Total Cost | | 42.182 | 1.676 | 1.856 | |
| Project 5028 R-1 | Shopping List - Item No. 9-24 of 9-35 | | Exhibit R-2a (F | PE 0602500F) | |

| Exhibit R-2a, RD | T&E Project Justification | DATE February 2004 |
|---|--|--|
| BUDGET ACTIVITY D2 Applied Research | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH | PROJECT NUMBER AND TITLE 5028 Space Sensors, Photonics & RI Proc |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | |
| U) D. Acquisition Strategy Not Applicable. | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Project 5028 | R-1 Shopping List - Item No. 9-25 of 9-35 | Exhibit R-2a (PE 0602500F |

| | Exi | hibit R-2a, I | RDT&E Pro | oject Justif | ication | | | | DATE | February | 2004 |
|---|---|--|--|---|---|--|---------------------------------|------------------------|------------------------|-------------------------------------|-------------------------|
| | ET ACTIVITY oplied Research | | | C | PE NUMBER AND 0602500F MU 1602500F MU | LTI-DISCIPLI | NARY | | | BER AND TITLE Sensor & CM | Tech |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2 | 2009 | Cost to | Total |
| | · · · | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Esti | | Complete | |
| 5029 | Space Sensor & CM Tech | 6.665 | 10.599 | 5.213 | 1.526 | 5.089 | 7.145 | | 6.126 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles In FY 2003, space unique efforts transfer | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | |
| (U) | mendation to consolidate all space unique <u>A. Mission Description and Budget Iter</u> This project focuses on developing process space sensor applications. This project de comprehensive communications and situar electronic countermeasures for space appli | n Justification sses and technic evelops the base ational awarenes | ues for electro line technolog | nic and electro ies required to | magnetic signation manage and period | l processing for rform on-board | r intelligence, space sensor | surveilla | ince, and tion fusi | l reconnaissance on for timely a | ce (ISR) nd |
| (U) M a (U) I b a (U) I c ii F e | 8. Accomplishments/Planned Program (MAJOR THRUST: Develop compact, affe ommunications, Global Positioning Syste nd Reconnaissance (ISR) space sensors. n FY 2003: Fabricated critical componen andgap devices for use in multi-mode/mu rchitecture for performing wideband direct n FY 2004: Fabricate and test compact, a ommunications, GPS, radar, electronic was nto operational radar and electronic warfa erforming wideband direct digital synthes lectronic/photonic digital receiver for Mo n FY 2005: Not Applicable. | ordable, multi-f m (GPS), radar ts consisting of lti-function dig ct digital synthe ffordable, multi arfare, and othe re digital receiv sis from aerospa | electronic was gallium arseni ital receiver pro- sis from space -function recei r ISR space ser er/exciter mod ace platforms. | rfare, and other de, indium pho ototype module platforms. iver/exciter and nsors. Evaluate ules. Demonst Perform a com | Intelligence, S sphide, silicon, es, and demonst phased array c integrating the rate a feasible a ponent evaluati | and/or wide rated a feasible omponents for ese components irchitecture for on of an | • | <u>7 2003</u> 1.709 | | <u>FY 2004</u> 2.316 | <u>FY 2005</u> 0.000 |
| (U) I (U) I (U) I c | AJOR THRUST: Develop and integrate hased array antennas used in military ISR n FY 2003: Developed robust component perate with limited environmental control n FY 2004: Develop the proof of concept ooling, and strong, undesired electromagr n FY 2005: Develop T/R channels that ar | space sensors. ts for L-band an ls and under sev of T/R channel netic radiation. | d X-band trans ere electromag | smitter and rece gnetic signals. to withstand ra | eiver (T/R) char diation, limited | nnels that or no active | | 0.087 | | 1.206 | 1.715 |
| Proje | ct 5029 | | R-1 SI | hopping List - Iter | m No. 9-26 of 9-3 | 5 | | | | Exhibit R-2a (I | PE 0602500F) |
| | | | | 189 |)) | | | | | | |

| Exhibit R-2a, RDT&E Pro | Exhibit R-2a, RDT&E Project Justification | | | | | | | | |
|--|--|---|-----------------|--------------|--|--|--|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH | PROJECT NUMBER AND TITLE 5029 Space Sensor & CM Tech | | | | | | | |
| undesired electromagnetic radiation. | | | | | | | | | |
| (U) (U) MAJOR THRUST: Develop X-band sub-assemblies based on flexible ra (U) In FY 2003: Developed X-band sub-assemblies based on flexible RF me band transmitter and receiver channels integrated at the subarray level fo (U) In FY 2004: Develop a large area (>0.5 m2) active aperture based on fle assembly costs and mass over conventional phased arrays by an order of | embranes that enable low-cost and low mass r space applications. In the the transformation of transformation o | 0.514 | 0.540 | 0.507 | | | | | |
| (U) In FY 2005: Develop and investigate approaches and techniques to prod aperture using advanced highly integrated and lightweight radio frequence reduction in assembly cost and aperture mass. | uce large area (>40 m2) active spaceborne | | | | | | | | |
| (U) | | 0 101 | 0.000 | 0.000 | | | | | |
| (U) MAJOR THRUST: Develop space-qualified micro-electro-mechanical s (U) In FY 2003: Characterized and matured space-qualified micro-electro-mechanical switch lifetimes and able to operate over a ten-to-one bandwidt | hechanical systems phase shifters for | 0.101 | 0.000 | 0.000 | | | | | |
| (U) In FY 2004: Not Applicable.(U) In FY 2005: Not Applicable. | | | | | | | | | |
| | | 0.514 | 0.422 | 0.456 | | | | | |
| (U) MAJOR THRUST: Develop two- and three-dimensional interconnects f (U) In FY 2003: Refined materials and processes for two-dimensional and th applications. | | 0.514 | 0.433 | 0.456 | | | | | |
| (U) In FY 2004: Develop mixed signal receiver/processor multi-functionalit two-dimensional and three-dimensional interconnects. | y on flexible RF membranes using advanced | | | | | | | | |
| (U) In FY 2005: Perform environmental testing of the multi-functional flex a three-dimensional interconnect approaches to determine their applicability | | | | | | | | | |
| (U) (U) MAJOR THRUST: Develop techniques to accurately predict scattering pelectromagnetic radiation. | phenomenology associated with | 0.620 | 0.559 | 0.557 | | | | | |
| (U) In FY 2003: Refined the accuracy of predictions of the scattering phenor radiation returned from objects or backgrounds when viewed from space | | | | | | | | | |
| (U) In FY 2004: Further refine the accuracy of exploitation of the scattering electromagnetic radiation returned from objects or backgrounds when vio | phenomenology associated with | | | | | | | | |
| (U) In FY 2005: Complete refinement of the accuracy of exploitation of the electromagnetic radiation returned from objects or backgrounds when via enhancements to target recognition using these techniques. | scattering phenomenology associated with | | | | | | | | |
| | hopping List - Item No. 9-27 of 9-35 | | Exhibit R-2a (F | PE 0602500F) | | | | | |

| Exhibit R-2a | , RDT&E Project Justification | DA | February | 2004 |
|--|--|-------|----------------------------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH | | IMBER AND TITLE e Sensor & CM | Tech |
| (U) (U) MAJOR THRUST: Develop space-qualified precision t jamming environments enabling multiple platform sense (U) In FY 2003: Developed Global Positioning System (GF hostile radio frequency (RF) environments with emphas Developed virtual flight test technology for improved as (U) In FY 2004: Design robust precision time, position, and sensor-to-shooter network-centric engagement. Develop techniques for operation in hostile RF environments. (U) In FY 2005: Develop robust precision time, position, and centric engagement. Evaluate synergistic GPS jamming | or-to-shooter operations. PS) specific jamming mitigation techniques for operation in is on synergistic integration of anti-jam technologies. sessment of reference sensors for space applications. I velocity sensor technologies for multi-platform o synergistic global positioning system jamming mitigation and velocity sensor technologies for multi-platform network | 1.530 | 3.203 | 1.638 |
| environments (U) (U) MAJOR THRUST: Develop technology to enable affor receivers. (U) In FY 2003: Modeled threat identification algorithms for the second se | dable upgrades to space-qualified radio frequency signal or next generation threat warning receivers. Evaluated l receiver subsystems with Gallium Arsenide and Indium | 1.590 | 0.342 | 0.340 |
| (U) In FY 2004: Continue modeling threat identification alg Continue evaluating state-of-the-art digital and software narrowband space applications. (U) In FY 2005: Model threat identification algorithms for a state-of-the-art digital and software receiver techniques applications. (U) | receiver techniques for radar, electronic warfare, and next generation threat warning receivers. Evaluate | | | |
| (U) MAJOR THRUST: Develop technology for an affordat (U) In FY 2003: Not Applicable. (U) In FY 2004: Further develop a system brassboard of the to demonstrate the technical readiness of the most critica 2003 this work was started in Project 5028 under this prime provide the technical readiness of the system brassboard of the provide the technical readiness of the most critical 2003 this work was started in Project 5028 under this prime provide the technical readiness of the project 5028 under the provide the provide the technical readiness of the provide the provide the technical readiness of the provide the | e Active Electronic Scanned Antenna and On-Board Processor al element of an affordable Space-Based Radar. Note: In FY | 0.000 | 2.000 | 0.000 |
| (U) In FY 2005: Not Applicable.(U) Total Cost | | 6.665 | 10.599 | 5.213 |
| Project 5029 | R-1 Shopping List - Item No. 9-28 of 9-35 | | Exhibit R-2a (F | PE 0602500F) |

| Exhibit R-2a, RDT& | E Project Justification | DATE February 2004 |
|---|--|---|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH | PROJECT NUMBER AND TITLE 5029 Space Sensor & CM Tech |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | |
| (U) D. Acquisition Strategy Not Applicable. | | |
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| | | |
| Project 5029 | R-1 Shopping List - Item No. 9-29 of 9-35 | Exhibit R-2a (PE 0602 |

| | Ex | hibit R-2a, I | RDT&E Pro | oject Justif | fication | | | | DATE | February | 2004 |
|---|--|--|----------------------------------|--------------------------------------|---|-------------------------------|-----------------------------------|---------------------------------|-------|-----------------------------------|-------------------------|
| | ET ACTIVITY oplied Research | | | 0 | PE NUMBER AND 0602500F MUI SPACE TECH | LTI-DISCIPLI | NARY | | | BER AND TITLE Space Acce | ss Vehicle |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 20 | | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estim | | Complete | |
| 5030 | Applied Space Access Vehicle Tech | 1.232 | 0.000 | 0.000 | | 3.907 | 8.246 | | 7.321 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles In FY 2003, space unique efforts transfer | | 0 | 0 | Ŷ | 0 | 0 | | 0 | 1 | 1.1 |
| (U) | A. Mission Description and Budget Iter This project develops technologies in area technologies contribute significantly towa enhanced mission effectiveness, improved | m Justification as of advanced s ards the develop | structures, flight | nt controls, and le, responsive s | l aerodynamics space access sys | to enable afford | lable on-dema aft-like operat | | • | - | - |
| (U) M 1a (U) I a b a <li< th=""><th>3. Accomplishments/Planned Program (MAJOR THRUST: Develop advanced str aunch for affordable on-demand military a n FY 2003: Developed advanced structur operations for affordable on-demand milita aws to expand the launch vehicle perform n a virtual environment. n FY 2004: Not Applicable. n FY 2005: Not Applicable. Cotal Cost</th><th>ucture, flight co access to space. re, flight control ary access to spa</th><th>, and aerodyna ace. Defined a</th><th>mic technologi and developed i</th><th>ies to enable air</th><th>craft-like nce and control</th><th></th><th><u>7 2003</u> 1.232 1.232</th><th></th><th><u>FY 2004</u> 0.000</th><th><u>FY 2005</u> 0.000</th></li<> | 3. Accomplishments/Planned Program (MAJOR THRUST: Develop advanced str aunch for affordable on-demand military a n FY 2003: Developed advanced structur operations for affordable on-demand milita aws to expand the launch vehicle perform n a virtual environment. n FY 2004: Not Applicable. n FY 2005: Not Applicable. Cotal Cost | ucture, flight co access to space. re, flight control ary access to spa | , and aerodyna ace. Defined a | mic technologi and developed i | ies to enable air | craft-like nce and control | | <u>7 2003</u> 1.232 1.232 | | <u>FY 2004</u> 0.000 | <u>FY 2005</u> 0.000 |
| (U) | C. Other Program Funding Summary () | \$ in Millions) | | | | | | | | | |
| (U) I (U) I (U) I (U) I (U) I (U) S | FY | <u>2003</u> FY | | <u>FY 2005</u> Estimate | FY 2006 Estimate | FY 2007 Estimate | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2(</u> <u>Estin</u> | | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| Proje | ct 5030 | | R-1 S | hopping List - Ite | m No. 9-30 of 9-3 | 5 | | | | Exhibit R-2a (I | PE 0602500F) |
| | | | | 19; | | | | | | | |

| Exhibit R-2a, RDT | F&E Project Justification | DATE February 2004 |
|--|--|---|
| BUDGET ACTIVITY D2 Applied Research | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH | CT NUMBER AND TITLE Applied Space Access Vehicle |
| U) C. Other Program Funding Summary (\$ in Millions) Technology Dev/Demo. This project has been coordinated through the U) Reliance process to harmonize efforts and eliminate duplication. U) D. Acquisition Strategy Not Applicable. | | |
| Project 5030 | R-1 Shopping List - Item No. 9-31 of 9-35 | Exhibit R-2a (PE 0602500F |

| | ExI | hibit R-2a, I | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|--------------------------|--|--|--|--|--|---|---|--|--|-------------------------------|
| | BET ACTIVITY pplied Research | | | 0 | PE NUMBER AND 0602500F MUI SPACE TECH | LTI-DISCIPLI | NARY | PROJECT NUME | BER AND TITLE Antennas Tec | h |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ III Millions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 5081 | | 0.000 | 1.056 | 1.406 | 1.509 | 1.617 | 5.233 | 5.237 | 0.000 | 0.000 |
| | Quantity of RDT&E Articles In FY 2004, space antenna efforts in PE 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) (U) | A. Mission Description and Budget Iter This project develops the technology base Enabling antenna technologies developed and communications system ownership, w Systems, nanostructures, metamaterials, r and stripline feed networks for limited sca be implemented in order to achieve simul B. Accomplishments/Planned Program (| e for lightweigh l under this proj while increasing igidizable syste an, and planar a taneous multipl | t satellite anten ect for satellite performance. ms, and adapti nd conformal a | terminals and s Novel antenna ve polymers wi architectures us | satellite trackin architectures b ill be developed ing overlapped | g will focus on based on emerg l. The project subarrays. Dig | significantly ing technologi will include ne gital Beamforr esis, and neura | lowering the life es such as Micro ew approaches to ning (DBF) on t | e cycle cost of se o-Electro-Mech o multi-layer m ransmit and rec | ensors anical icrostrip |
| (U) (U) (U) (U) | MAJOR THRUST: Develop lightweight a sensors for low life cycle cost communicat In FY 2003: Not Applicable. In FY 2004: Develop lightweight antenna for low life cycle cost communications, de In FY 2005: Evaluate lightweight antenna for low life cycle cost communications, de | antenna technolo tions, detection technologies co tection of air an technologies co | of air and grou oncepts that ena d ground movi oncepts that en | nd moving targ able affordable ing targets, and able affordable | deployment of remote sensing deployment of | e sensing. space sensors g. space sensors | <u> </u> | 0.000 | 0.336 | 0.451 |
| (U) (U) (U) (U) | MAJOR THRUST: Develop new lightwei concepts for advanced wideband phased ar In FY 2003: Not Applicable. In FY 2004: Develop new lightweight rad advanced wideband phased array antenna a In FY 2005: Evaluate new lightweight rad advanced wideband phased array antenna a | iators, transmis architectures. liators, transmis | hitectures. sion mechanisr | ns, and control | components an | nd concepts for | | 0.000 | 0.316 | 0.429 |
| (U) | MAJOR THRUST: Develop concepts for implement simultaneous multiple-beams, c beamforming. | - | - | | - | | | 0.000 | 0.404 | 0.526 |
| Proj | ect 5081 | | R-1 SI | hopping List - Iter | m No. 9-32 of 9-3 | 5 | | | Exhibit R-2a (F | PE 0602500F) |

| | | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | | DATE | | 2004 | |
|------------|--|---------------------------------|-----------------------------------|-----------------------------------|---------------------------------------|-----------------------------------|-----------------------------------|---|---------------------|-----------------------------------|-------------------|--|
| | GET ACTIVITY Applied Research | | | | PE NUMBER A | IULTI-DISCIPL | INARY | February 2004 PROJECT NUMBER AND TITLE 5081 Space Antennas Tech | | | | |
| (U) (U) | In FY 2003: Not Applicable. In FY 2004: Develop concepts fo implement simultaneous multiple- beamforming. In FY 2005: Evaluate Digital Bea multiple-beams, conformal array b Total Cost | -beams, conformal | array beamforn transmit and re | ning, array patte | rn synthesis, and order to impleme | l neural | | 0.000 | | 1.056 | 1.406 | |
| (U) | C. Other Program Funding Sur | • | | | | | | | | | | |
| | PE 0602204F, Aerospace Sensors. PE 0603203F, Advanced Aerospace Sensors. PE 0603500F, Multi-Disciplinary Adv Dev Space Technology. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2</u> <u>Esti</u> | <u>2009</u> mate | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> | |
| (U) | Not Applicable. | | | | | | | | | | | |
| Pro | oject 5081 | | F | R-1 Shopping List | Item No. 9-33 of 9 | 9-35 | | | | Exhibit R-2a (| PE 0602500F) | |

| bit Description Sold Optical Networking Tech 5082 Optical Networking Tech 0< | | Exhibit R-2a, I | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|---|--|---|---|--|--|--|--|---|--|---|
| Cost (s) in Millions)ActualEstimateEstimateEstimateEstimateEstimateEstimateComplete5082Optical Networking Tech0.0006.0654.9204.8894.8784.8654.8530.0000.000Quantity of RDT8E Articles000< | BUDGET ACTIVITY 02 Applied Research | | | C | 602500F MU | LTI-DISCIPLI | NARY | | | ſech |
| Optical Networking Tech Output Estimate | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| Quantity of RDT&E Articles 0 </th <th></th> <th></th> <th>Estimate</th> <th>Estimate</th> <th></th> <th></th> <th></th> <th></th> <th>Complete</th> <th></th> | | | Estimate | Estimate | | | | | Complete | |
| Note: In FY 2004, in Project 5082, the Air Force increased emphasis on developing optical networks for space-based applications. (U) A.Mission Description and Budget Item Justification This project develops the technology base for the next generation of ultra-wide- bandwidth, multi-channeled, space-based optical networks, on and between platforms. As the application of laser-based, point-to-point communications between satellites emerges, space-based optical networks, whose communications capacities are thousands of times greater than current communications between satellites is project is to assess and adapt the emerging communication and information technologies, being developed for next-generation Intermet, for applications in space. This project will explore technologies of a paplications in specific military systems including reliable, high bandwidth, jam-resistant communications at the theater level, and multiple Acousty pa pertending and logistics. (U) B.Accomplishments/Planned Program (S h Millinos) FY 2003 FY 2004 FY 2005 (U) B.Accomplishments/Planned Program (S h Millinos) FY 2003 FY 2004 FY 2005 (U) In FY 2004: Assess, explore, and adapt the emerging communication and information technologies for application in the space environment. 0.000 1.989 1.932 (U) In FY 2004: Assess, explore, and adapt the emerging communications. Evelop and the teresing economentications in the space environment. 0.000 1.989 1.932 (U) In FY 2004: Assess, explore, and | | | | | | | | | 0.000 | 0.000 |
| (U) A. Mission Description and Budget Item Justification This project develops the technology base for the next generation of ultra-wide-bandwidth, multi-channeled, space-based communications networks on and between platforms. As the application of laser-based, point-to-point communications satellites, become a realistic possibility. A major thrust of this project is to assess and adapt the emerging communication and information technologies, being developed for next-generation Internet, for applications in space. This project will explore technologies hold developed for optic, wireless, and satellite networks that can be built from them. This technologies has potential applications in space in military systems including reliable, high bandwidth, jam-resistant communications at the theater level, and multiplexed (WDM) transceivers and prototype networks, built to demonstrate the benefits associated with the advanced fiber optic, wireless, and statellite networks that can be built from them. This technology has potential applications in specific military systems including reliable, high bandwidth, jam-resistant communications at the theater level, and multiplexed (WDM) transceivers and prototype networks, built to demonstrate the benefits associated with the advanced fiber optic, wireless, and statellite networks that can be built from them. This technology has potential applications in specific libel, high bandwidth, jam-resistant communications at the theater level, and multiplexed (WDM) transceivers and prototype networks, built of applications in specific and seases optical network technologies for application in the space environment. (U) MAJOR THRUST: Develop and assess optical network technologies for application in the space environment. Initiate design and developed for a multi-path interconnection network that provides for redundary, fault tolerance, self-configuring high cap | | ÷ | | Ŷ | ŷ | ţ | | 0 | | |
| heterogeneous, seamless, secure, self-configuring high capacity network technologies and study their applicability to integrated Air, Space, Ground Networks Supporting Network Centric Operations. Develop variable data rate, networked data link radio frequency/optical hardware and their associated ground stations. Develop transmission technology and control concepts to support optically networked communications. (U) (U) MAJOR THRUST: Develop and assess existing and emerging Optical Code Division Multiple Access and 0.000 2.061 2.002 Wavelength Division Multiplexed modulation schemes and protocols for use in space-based optical networks. (U) In FY 2003: Not Applicable. (U) In FY 2004: In conjunction with industry and academia, develop or adapt appropriate standards to ensure the evolution of open systems architecture for space-based optical networks. | This project develops the technologic platforms. As the application of la are thousands of times greater than communication and information terimplementing photonic chip scale of built to demonstrate the benefits as applications in specific military system a common networking infrastructur (U) B. Accomplishments/Planned Pro (U) MAJOR THRUST: Develop and as (U) In FY 2003: Not Applicable. (U) In FY 2004: Assess, explore, and are for next-generation Internet, for app (U) In FY 2005: Complete assessment of the system of the system of the system of the system. | gy base for the next ge ser-based, point-to-point current communication chnologies, being developtical Code Division ssociated with the advast stems including reliable re for reduced manning gram (\$ in Millions) ssess optical network to dapt the emerging com- plications in space. | nt communica ons satellites, b cloped for next Multiple Acces nced fiber opti e, high bandwi g and logistics. echnologies for munication an rnet arrayed-w | tions between s ecome a realist -generation Int ss (CDMA) and c, wireless, and idth, jam-resist r application in d information t aveguide gratin | satellites emerg ic possibility. A ernet, for applic d Wavelength E d satellite netwo ant communica the space envir technologies be | es, space-based A major thrust cations in space Division Multip orks that can be tions at the the ronment. ing developed for applicatior | l optical netwo of this project e. This project lexed (WDM) built from the ater level, and <u>FY</u> | orks, whose com- is to assess and will explore tea transceivers an em. This technor multiplexing of <u>X 2003</u> | adapt the emerges adapt the emerges chnologies for d prototype netwo ology has potent is multiple DoD u <u>FY 2004</u> | pacities ging works, ial users onto <u>FY 2005</u> |
| | heterogeneous, seamless, secure, selintegrated Air, Space, Ground Networked data link radio frequency technology and control concepts to a (U) (U) MAJOR THRUST: Develop and as Wavelength Division Multiplexed no (U) In FY 2003: Not Applicable. (U) In FY 2004: In conjunction with integration of the second /li> | If-configuring high cap yorks Supporting Netw //optical hardware and support optically netwo ssess existing and emen nodulation schemes an dustry and academia, c | vacity network ork Centric Op their associate orked commun ging Optical O d protocols for levelop or adap | technologies a perations. Deve d ground statio lications. Code Division N use in space-b pt appropriate s | nd study their a elop variable da ons. Develop tra Multiple Access pased optical net | pplicability to ta rate, ansmission and tworks. | | 0.000 | 2.061 | 2.002 |
| | Project 5082 | - • | R-1 SI | hopping List - Iter | m No. 9-34 of 9-3 | 5 | | | Exhibit R-2a (F | PE 0602500F) |

| | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | | DATE February | 2004 |
|---|--|---|---|--|--|-----------------------------------|--|------------------|-------------------|
| BUDGET ACTIVITY 02 Applied Research | | PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH | | | | | PROJECT NUMBER AND TITLE 5082 Optical Networking Tech | | |
| (U) In FY 2005: Develop or adapt, alcopen systems architecture for space and optical label switching protocol (U) MAJOR THRUST/CONGRESSIC optimize network components and million for Photonics Technology. (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop photonic chi Wavelength Division Multiplexed evaluate, and optimize optical network. (U) In FY 2005: Develop and evaluate components (transmitters, receiver) | e-based optical ne ols for applicabilit DNAL ADD: Esta technologies for ip scale optically (WMD) transceiv work components e performance of p | etworks. Investi y to space-based ablish and maint space applicatio implemented Co yers and laborato and technologie passive and activ | de Division Mu ry network into s for space appli e optical emerging te | errestrial optical cs. to characterize, of 2004, Congress ltiple Access (C a capability to c cations. onic chip-scale n | burst switching evaluate, and s added \$1.0 DMA) and haracterize, etworking | | 0.000 | 2.015 | 0.986 |
| second. U) Total Cost | s, switches) for C | | on board netw | orks operating a | t gigaons per | | 0.000 | 6.065 | 4.920 |
| (U) <u>C. Other Program Funding Sum</u> (U) PE 0602702F, Command, Control, and Communications. (U) PE 0603789F, C3I Advanced Development. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. | 1 mary (\$ in Milli <u>FY 2003</u> <u>Actual</u> | ons) FY 2004 Estimate | <u>FY 2005</u> <u>Estimate</u> | FY 2006 Estimate | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2</u> Esti | | <u>Total Cost</u> |
| Project 5082 | | F | R-1 Shopping List | Item No. 9-35 of 9 | 9-35 | | | Exhibit R-2a | (PE 0602500F) |

PE NUMBER: 0602601F

| Exhi | bit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 |
|---|---|---|--|--|---|---|--|--|---|
| UDGET ACTIVITY 2 Applied Research | | | | E NUMBER AND 602601F Spa | | gy 1 | | | |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| · · · · · | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| Total Program Element (PE) Cost | 74.889 | 101.539 | 88.909 | 89.644 | 97.609 | 118.971 | 126.742 | 0.000 | 0.0 |
| 010 Space Survivability & Surveillance | 30.276 | 43.080 | 40.002 | 39.466 | 42.160 | 40.843 | 41.510 | 0.000 | 0.0 |
| 4846 Spacecraft Payload Technologies | 12.431 | 16.937 | 19.553 | 20.608 | 20.735 | 35.740 | 39.529 | 0.000 | 0.0 |
| 5018 Spacecraft Protection Technology | 4.355 | 4.011 | 2.630 | 2.442 | 2.303 | 2.434 | 2.516 | 0.000 | 0.0 |
| 8809 Spacecraft Vehicle Technologies Note: In FY 2003, Project 1010 was split, with | 27.827 | 37.511 | 26.724 | 27.128 | 32.411 | 39.954 | 43.187 | 0.000 | 0.0 |
| environments on the design and operatio component and subsystem capabilities. 7 area, spacecraft vehicles focuses on spac High-frequency Active Auroral Research Very Large Scale Integrated (Circuits) for Substrates for Solar Cells \$1.0 million f | Third, spacecraft ecraft platform, p n Program (HAA) or Space Vehicle | protection deve oayload, and co RP) Space Tec Communicatio | elops technolog ontrol technolog hnology, \$2.1 r ns Subsystems | gies for protecting gies, and their i million for Elect , \$3.0 million f | ing U.S. space nteractions. No tromagnetic G or Technology | assets in potent ote: In FY 2004 radiometer Rese Satellite of the | ial hostile setti 4, Congress ad earch, \$1.8 mil 21st Century, 3 | ngs. The last n ded \$5.0 millio llion for Mixed \$1.2 million for | najor n for Signal r |
| component and subsystem capabilities. 7 area, spacecraft vehicles focuses on space High-frequency Active Auroral Research Very Large Scale Integrated (Circuits) for Substrates for Solar Cells, \$1.0 million for Memory Composite Materials, \$1.5 million Cells. This program is in Budget Activity 2, Approximate the space technologies. | Third, spacecraft ecraft platform, p n Program (HAA) or Space Vehicle or Integrated Cont ion for Converted oplied Research, s | protection devo payload, and co RP) Space Tec Communicatio atrol for Autono d Silicon Carbio | elops technolog ontrol technolog hnology, \$2.1 r ns Subsystems omous Space S de for High Per | gies for protect gies, and their i nillion for Elec , \$3.0 million f ystems, \$1.5 m formance Opti | ng U.S. space nteractions. No tromagnetic G or Technology illion for Elast c Structures, ar | assets in potent ote: In FY 2004 radiometer Reso Satellite of the ic Memory Con ad \$2.3 million | ial hostile setti 4, Congress ad earch, \$1.8 mil 21st Century, 5 nposites, \$1.8 f for Affordable | ngs. The last n ded \$5.0 millio llion for Mixed \$1.2 million for million for Elas Multi-Junction | najor n for Signal r stic Solar |
| component and subsystem capabilities. area, spacecraft vehicles focuses on space High-frequency Active Auroral Research Very Large Scale Integrated (Circuits) for Substrates for Solar Cells, \$1.0 million for Memory Composite Materials, \$1.5 million Cells. This program is in Budget Activity 2, Appendix 2012 | Third, spacecraft ecraft platform, p n Program (HAA) or Space Vehicle or Integrated Cont ion for Converted oplied Research, s | protection devo payload, and co RP) Space Tec Communicatio atrol for Autono d Silicon Carbio | elops technolog ontrol technolog hnology, \$2.1 r ns Subsystems omous Space S de for High Per | gies for protect gies, and their i nillion for Elec , \$3.0 million f ystems, \$1.5 m formance Opti | ng U.S. space nteractions. No tromagnetic G or Technology illion for Elast c Structures, ar l feasibility and | assets in potent ote: In FY 2004 radiometer Reso Satellite of the ic Memory Con ad \$2.3 million | ial hostile setti 4, Congress ad earch, \$1.8 mil 21st Century, 5 nposites, \$1.8 f for Affordable | ngs. The last n ded \$5.0 millio llion for Mixed \$1.2 million for million for Elas Multi-Junction ry and revolution | najor n for Signal r stic Solar |
| component and subsystem capabilities. 7 area, spacecraft vehicles focuses on space High-frequency Active Auroral Research Very Large Scale Integrated (Circuits) for Substrates for Solar Cells, \$1.0 million for Memory Composite Materials, \$1.5 milling Cells. This program is in Budget Activity 2, Approace technologies. U) B. Program Change Summary (\$ in Material Scale Scal | Third, spacecraft ecraft platform, p n Program (HAA) or Space Vehicle or Integrated Cont ion for Converted oplied Research, s | protection devo payload, and co RP) Space Tec Communicatio atrol for Autono d Silicon Carbio | elops technolog ontrol technolog hnology, \$2.1 r ns Subsystems omous Space S de for High Per | gies for protect gies, and their i nillion for Elec , \$3.0 million f ystems, \$1.5 m formance Opti | ng U.S. space nteractions. No tromagnetic G or Technology illion for Elast c Structures, ar l feasibility and | assets in potent ote: In FY 2004 radiometer Rese Satellite of the ic Memory Con ad \$2.3 million d military utility | ial hostile setti 4, Congress ad earch, \$1.8 mil 21st Century, 5 nposites, \$1.8 m for Affordable y of evolutiona <u>FY 2</u> | ngs. The last n ded \$5.0 millio llion for Mixed \$1.2 million for million for Elas Multi-Junction ry and revolution | najor n for Signal r stic Solar onary |
| component and subsystem capabilities. 7 area, spacecraft vehicles focuses on space High-frequency Active Auroral Research Very Large Scale Integrated (Circuits) for Substrates for Solar Cells, \$1.0 million for Memory Composite Materials, \$1.5 million for Memory Composite Materials, \$1.5 million for Memory Composite Materials, \$1.5 million for Substrates for Solar Cells, \$1.0 million for Memory Composite Materials, \$1.7 million for Memory Composite Materi | Third, spacecraft ecraft platform, p n Program (HAA) or Space Vehicle or Integrated Cont ion for Converted oplied Research, s | protection devo payload, and co RP) Space Tec Communicatio atrol for Autono d Silicon Carbio | elops technolog ontrol technolog hnology, \$2.1 r ns Subsystems omous Space S de for High Per | gies for protect gies, and their i nillion for Elec , \$3.0 million f ystems, \$1.5 m formance Opti | ng U.S. space nteractions. No tromagnetic G or Technology illion for Elast c Structures, ar l feasibility and | assets in potent ote: In FY 2004 radiometer Reso Satellite of the ic Memory Con ad \$2.3 million d military utility <u>FY 2003</u> | ial hostile setti 4, Congress ad earch, \$1.8 mil 21st Century, 5 nposites, \$1.8 m for Affordable y of evolutiona <u>FY 2</u> 83 | ngs. The last n ded \$5.0 millio llion for Mixed \$1.2 million for million for Elas Multi-Junction ry and revolution | najor n for Signal tic Solar onary <u>FY 2005</u> 90.810 |
| component and subsystem capabilities. ⁷ area, spacecraft vehicles focuses on space High-frequency Active Auroral Research Very Large Scale Integrated (Circuits) for Substrates for Solar Cells, \$1.0 million ff Memory Composite Materials, \$1.5 million Cells. This program is in Budget Activity 2, Approace technologies. B. Program Change Summary (\$ in M Previous President's Budget Current PBR/President's Budget | Third, spacecraft ecraft platform, p n Program (HAA) or Space Vehicle or Integrated Cont ion for Converted oplied Research, s | protection devo payload, and co RP) Space Tec Communicatio atrol for Autono d Silicon Carbio | elops technolog ontrol technolog hnology, \$2.1 r ns Subsystems omous Space S de for High Per | gies for protect gies, and their i nillion for Elec , \$3.0 million f ystems, \$1.5 m formance Opti | ng U.S. space nteractions. No tromagnetic G or Technology illion for Elast c Structures, ar l feasibility and | assets in potent ote: In FY 2004 radiometer Reso Satellite of the ic Memory Con id \$2.3 million d military utility <u>FY 2003</u> 76.239 | ial hostile setti 4, Congress ad earch, \$1.8 mil 21st Century, 5 nposites, \$1.8 m for Affordable y of evolutiona <u>FY 2</u> 83 101 | ngs. The last n ded \$5.0 millio llion for Mixed \$1.2 million for million for Elas Multi-Junction ry and revolution 2004 .240 | najor n for Signal tic Solar onary <u>FY 2005</u> 90.810 |
| component and subsystem capabilities. ' area, spacecraft vehicles focuses on space High-frequency Active Auroral Research Very Large Scale Integrated (Circuits) for Substrates for Solar Cells, \$1.0 million for Memory Composite Materials, \$1.5 million Cells. This program is in Budget Activity 2, Approximate the space technologies. B. Program Change Summary (\$ in M Previous President's Budget Current PBR/President's Budget J) Total Adjustments | Third, spacecraft ecraft platform, p n Program (HAA) or Space Vehicle or Integrated Cont ion for Converted oplied Research, s | protection devo payload, and co RP) Space Tec Communicatio atrol for Autono d Silicon Carbio | elops technolog ontrol technolog hnology, \$2.1 r ns Subsystems omous Space S de for High Per | gies for protect gies, and their i nillion for Elec , \$3.0 million f ystems, \$1.5 m formance Opti | ng U.S. space nteractions. No tromagnetic G or Technology illion for Elast c Structures, ar l feasibility and | assets in potent ote: In FY 2004 radiometer Reso Satellite of the ic Memory Con- id \$2.3 million d military utility <u>FY 2003</u> 76.239 74.889 | ial hostile setti 4, Congress ad earch, \$1.8 mil 21st Century, 3 nposites, \$1.8 m for Affordable y of evolutiona <u>FY 2</u> 83 101 18 | ngs. The last n ded \$5.0 millio llion for Mixed \$1.2 million for million for Elas Multi-Junction ry and revolution 2004 .240 .539 | najor n for Signal tic Solar onary <u>FY 2005</u> 90.810 |
| component and subsystem capabilities. ' area, spacecraft vehicles focuses on space High-frequency Active Auroral Research Very Large Scale Integrated (Circuits) for Substrates for Solar Cells, \$1.0 million for Memory Composite Materials, \$1.5 million Cells. This program is in Budget Activity 2, Approximation of the space technologies. B. Program Change Summary (\$ in M Previous President's Budget Current PBR/President's Budget J. Total Adjustments | Third, spacecraft ecraft platform, p n Program (HAA) or Space Vehicle or Integrated Cont ion for Converted oplied Research, s | protection devo payload, and co RP) Space Tec Communicatio atrol for Autono d Silicon Carbio | elops technolog ontrol technolog hnology, \$2.1 r ns Subsystems omous Space S de for High Per | gies for protect gies, and their i nillion for Elec , \$3.0 million f ystems, \$1.5 m formance Opti | ng U.S. space nteractions. No tromagnetic G or Technology illion for Elast c Structures, ar l feasibility and | assets in potent ote: In FY 2004 radiometer Rese Satellite of the ic Memory Con ad \$2.3 million d military utility FY 2003 76.239 74.889 -1.350 | ial hostile setti 4, Congress ad earch, \$1.8 mil 21st Century, 5 for Affordable y of evolutiona <u>FY 7</u> 83 101 18 -2 | ngs. The last n ded \$5.0 millio llion for Mixed \$1.2 million for million for Elas Multi-Junction ry and revolution 2004 .240 .539 .299 | najor n for Signal tic Solar onary <u>FY 2005</u> 90.810 |
| component and subsystem capabilities. ' area, spacecraft vehicles focuses on space High-frequency Active Auroral Research Very Large Scale Integrated (Circuits) for Substrates for Solar Cells, \$1.0 million for Memory Composite Materials, \$1.5 millicells. This program is in Budget Activity 2, Approximate the space technologies. J. Previous President's Budget J. Current PBR/President's Budget J. Total Adjustments J. Congressional Program Reductions | Third, spacecraft ecraft platform, p n Program (HAA) or Space Vehicle or Integrated Cont ion for Converted oplied Research, s | protection devo payload, and co RP) Space Tec Communicatio atrol for Autono d Silicon Carbio | elops technolog ontrol technolog hnology, \$2.1 r ns Subsystems omous Space S de for High Per | gies for protect gies, and their i nillion for Elec , \$3.0 million f ystems, \$1.5 m formance Opti | ng U.S. space nteractions. No tromagnetic G or Technology illion for Elast c Structures, ar l feasibility and | assets in potent ote: In FY 2004 radiometer Rese Satellite of the ic Memory Con ad \$2.3 million d military utility FY 2003 76.239 74.889 -1.350 | ial hostile setti 4, Congress ad earch, \$1.8 mil 21st Century, 5 for Affordable y of evolutiona <u>FY 2</u> 83 101 18 -2 -0 | ngs. The last n ded \$5.0 millio llion for Mixed \$1.2 million for million for Elas Multi-Junction ry and revolution 2004 .240 .539 .299 .032 | najor n for Signal tic Solar onary <u>FY 2005</u> 90.810 |
| component and subsystem capabilities. ' area, spacecraft vehicles focuses on space High-frequency Active Auroral Research Very Large Scale Integrated (Circuits) for Substrates for Solar Cells, \$1.0 million for Memory Composite Materials, \$1.5 millic Cells. This program is in Budget Activity 2, Approximate the space technologies. B. Program Change Summary (\$ in M Previous President's Budget Current PBR/President's Budget Total Adjustments Congressional Program Reductions Congressional Rescissions | Third, spacecraft ecraft platform, p n Program (HAA) or Space Vehicle or Integrated Cont ion for Converted oplied Research, s | protection devo payload, and co RP) Space Tec Communicatio atrol for Autono d Silicon Carbio | elops technolog ontrol technolog hnology, \$2.1 r ns Subsystems omous Space S de for High Per | gies for protect gies, and their i nillion for Elec , \$3.0 million f ystems, \$1.5 m formance Opti | ng U.S. space nteractions. No tromagnetic G or Technology illion for Elast c Structures, ar l feasibility and | assets in potent ote: In FY 2004 radiometer Reso Satellite of the ic Memory Con- id \$2.3 million d military utility FY 2003 76.239 74.889 -1.350 0.000 | ial hostile setti 4, Congress ad earch, \$1.8 mil 21st Century, 5 for Affordable y of evolutiona <u>FY 2</u> 83 101 18 -2 -0 | ngs. The last n ded \$5.0 millio llion for Mixed \$1.2 million for million for Elas Multi-Junction ry and revolution 2004 .240 .539 .299 .032 .869 | najor n for Signal tic Solar onary <u>FY 2005</u> 90.810 |
| component and subsystem capabilities. ' area, spacecraft vehicles focuses on space High-frequency Active Auroral Research Very Large Scale Integrated (Circuits) for Substrates for Solar Cells, \$1.0 million for Memory Composite Materials, \$1.5 millic Cells. This program is in Budget Activity 2, Approximate the space technologies. B. Program Change Summary (\$ in M Previous President's Budget Current PBR/President's Budget Total Adjustments Congressional Program Reductions Congressional Increases | Third, spacecraft ecraft platform, p n Program (HAA) or Space Vehicle or Integrated Cont ion for Converted oplied Research, s | protection devo payload, and co RP) Space Tec Communicatio atrol for Autono d Silicon Carbio | elops technolog ontrol technolog hnology, \$2.1 r ns Subsystems omous Space S de for High Per | gies for protect gies, and their i nillion for Elec , \$3.0 million f ystems, \$1.5 m formance Opti | ng U.S. space nteractions. No tromagnetic G or Technology illion for Elast c Structures, ar l feasibility and | assets in potent ote: In FY 2004 radiometer Reso Satellite of the ic Memory Con- id \$2.3 million d military utility FY 2003 76.239 74.889 -1.350 0.000 0.000 | ial hostile setti 4, Congress ad earch, \$1.8 mil 21st Century, 5 for Affordable y of evolutiona <u>FY 2</u> 83 101 18 -2 -0 | ngs. The last n ded \$5.0 millio llion for Mixed \$1.2 million for million for Elas Multi-Junction ry and revolution 2004 .240 .539 .299 .032 .869 | najor n for Signal tic Solar onary <u>FY 2005</u> |

R-1 Shopping List - Item No. 10-1 of 10-22

| | DT&E Budget Item Justification | DATE February 2004 |
|---|--|---------------------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602601F Space Technology 1 | |
| Changes to this PE since the previous President's Bud | get are due to higher Air Force priorities. | |
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| | R-1 Shopping List - Item No. 10-2 of 10-22 | Exhibit R-2 (PE 0602601F) |

| Evh | ibit R-2a, F | | viact lustif | ication | | | DA | ATE | |
|---|--|--|--|---|---|---|--------------|---|---|
| | iipit R-za, r | | | | | | | February | 2004 |
| BUDGET ACTIVITY 02 Applied Research | | | | PE NUMBER AND D602601F Spa | | gy 1 | | NUMBER AND TITLE Ice Survivability a Ince | & |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | | Total |
| | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | | |
| 1010 Space Survivability & Surveillance | 30.276 | 43.080 | 40.002 | 39.466 | 42.160 | 40.843 | 41.5 | | 0.000 |
| Quantity of RDT&E Articles Note: In FY 2003, Project 1010 was split, with e | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | |
| (U) A. Mission Description and Budget Item This project develops the technologies to environment for realistic space system dest technologies to specify and forecast the ensurveillance operations, and allow the opporthe seismic research program that supports (U) B. Accomplishments/Planned Program (S (U) MAJOR THRUST: Develop technologies for conditions hazardous to Department of Deforeduce cost, and increase operational lifetim (U) In FY 2003: Validated algorithms for track on DoD systems. Developed models and al susceptibility to single event upsets. Complifor spacecraft hazard forecasting. (U) In FY 2004: Develop advanced space weat with in situ plasma and fields data. Validate acquired data sets from operational DoD satisforecasting explosive solar events that gene clouds responsible for adverse communication nano-scale technology concepts for extreme (U) In FY 2005: Upgrade initial version of dyn solar shock events responsible for the worst high-resolution solar telescope and begin fa concepts to detect high-energy space particl in microsatellite constellations to specify sp physics based model development to improvi (U) Project 1010 | exploit the space ign, modeling, vironment from ortunity to mitic national requi- s national requi- leted initial dyn her forecasting e dynamic radi- tellites. Develop- rate spacecraft- ion and naviga- ely small space amic radiation conc- brication of ne- les using micro- pace weather. I | and simulation n "mud to sun" gate or exploit rements for mo- monitoring, pro- erational space na clouds to Ea ropagation of s namic radiation g models combi- ation belt mode op advanced tea- damaging ener- tion effects. De hazard detector belt specificati- litions. Compl xt-generation s - and nano-tecel Build empirical d lead-times for | h, as well as the for planning of the space envir- onitoring nucle edicting, and c systems in ord rth and predict olar/geomagne h belt model with aning remote se el for satellite l chnology solar rgetic particle of evelop capabil ors. ton and forecass ete conceptual solar hazard for hnology based l solar flare for or prediction of | e battlespace en operations and e ironment for bot ear explosions. controlling space der to improve p ting onsets of ad etic activity for s ith real-time dat ensing of interpl hazard forecasts r telescope for d events and initia ity to test sub-m st model to inclu design of advar recasting tool. The sensors suitable recast algorithms | vironment's eff insuring uninter th offensive and e environmenta performance, lverse effects spacecraft a assimilation lanetary clouds is with newly etecting and ate plasma nicron and ude extreme nced, Test novel e for inclusion s and initiate plosive events. | ect on space syrupted system d defensive op <u>FY</u> | ystems' perf | formance. It include | es based ncludes <u>FY 2005</u> 4.207 |

| Exhibit R-2a, RDT&E Proj | ject Justification | DA | February | 2004 |
|---|--|-------|-----------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602601F Space Technology 1 | | UMBER AND TITLE | |
| (U) MAJOR THRUST: Develop real-time infrared backgrounds clutter code, techniques, and decision aids for application to space-based surveillance, including detection of low-observable targets. | | 7.650 | 9.880 | 13.008 |
| (U) In FY 2003: Validated background models with new experimental data at trades and performance analyses. From field measurements, determined to detection of theater ballistic missiles in boost phase. Upgraded models of improved laser weapon performance prediction model of airborne and spa techniques to exploit hyperspectral data and validate hyperspectral perform Developed design requirements for space-based sensor to obtain sub-pixel optical/infrared backgrounds for next-generation operational surveillance, | rade space for space system for earliest atmospheric turbulence sources and ice-based systems. Developed advanced mance modeling and simulation codes. I, high spectral resolution measurements of | | | |
| assessment systems. (U) In FY 2004: Develop all-altitude, sub-pixel infrared background radiance extended radiance sources such as missile hard bodies and plumes. Test a performance prediction tools, including theater ballistic missile boost phase Expand models for other high-energy laser systems and explore a forecast effects on aircraft platforms. Develop sensors, algorithms, and clutter rem hypertemporal imaging sensor. Incorporate spectral signature variability i performance predictions. Collect high quality spectral data from existing for theater surveillance and area search missions. | and validate decision aids and turbulence se negation, on airborne laser platform. ting capability for high altitude turbulence noval techniques for space-based into simulation codes to improve | | | |
| (U) In FY 2005: Validate and deliver all-altitude, sub-pixel infrared backgrou sources. Upgrade and improve atmospheric turbulence models for use in systems. Improve turbulence forecast technology for a turbulence decisio advanced on-chip digital signal processing technologies for real-time hype spectral exploitation algorithms and related signature databases for specifi desert, and woodlands. Use validated simulations to evaluate candidate te and area search missions. | decision aids for tactical high-energy laser n aid for high altitude air vehicles. Develop ertemporal detection. Validate day/night ic environments such as littoral, agricultural, | | | |
| (U) (U) MAJOR THRUST: Develop artificial intelligence techniques, forecasting ionospheric specification and forecasting, including communications/navi geolocation demonstrations, and determination and prediction of radar deg (U) In FY 2003: Developed data processing software and hardware architecture | gation outage forecasting, space-based gradation. | 7.114 | 6.708 | 5.966 |
| space data to provide near-real-time nowcasts and forecasts of ionospheric predictions using ground and space-based experimental databases and incorreduction. Improved techniques to track the motion of the highly structure Project 1010 R-1 Sho | orporated results into forecast tool risk | | Exhibit R-2a (I | PE 0602601F) |

| Exhibit R-2a, RDT8 | E Project Justification | DA | TE February | 2004 |
|---|--|-------|-------------------------------------|-----------------|
| BUDGET ACTIVITY 02 Applied Research | | | UMBER AND TITLE Ce Survivability | |
| reliability of ionospheric specification in high latitude theaters. I reliability of global ionospheric forecasts. | Developed multi-scale algorithms to increase | | | |
| (U) In FY 2004: Develop nowcasting and forecasting validation algo Communication/Navigation Outage Forecasting System (C/NOF Integrate validation algorithms into ionospheric specification and communication and navigation outage forecasts with C/NOFS sa of outage warning due to scintillation. Integrate polar region plas scintillation to provide seamless equator-to-pole outage specifica assimilation techniques to increase reliability of global ionospher improve radar and geolocation performance. Explore concept de overcome satellite-to-ground link degradation in real-time. | S) Advanced Concept Technology Demonstration. I forecast modeling architecture. Validate Itellite and ground-based data to demonstrate utility sma tracking models into global models of Ition. Validate multi-scale algorithms and data ric electron profile specifications and forecasts to | | | |
| (U) In FY 2005: Generate communication/navigation outage nowcas give the warfighter improved battlefield situational awareness an ionospheric specification and forecast models and products using Advanced Concept Technology Demonstration. Investigate iono techniques for longer-term outage forecasting. Complete pole-to global real-time hazard alerts. Couple magnetospheric data assin electron profile models to improve geolocation accuracy and incr Develop combined laboratory/field tests to demonstrate feasibilit hazardous scintillation conditions. | d operational flexibility. Develop validated g results from military evaluation of C/NOFS ospheric scintillation technologies to develop o-equator scintillation specification model giving milation and forecast models to validated ionospheric rease forecast lead times for radar operations. | | | |
| (U)(U) MAJOR THRUST: Develop High-frequency Active Auroral Res | search Program site transmitting and diagnostic | 0.000 | 9.684 | 10.000 |
| instrument infrastructure. | | | | |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Continue populating the high frequency transmitter 3.6 megawatt radiated output power. | array to its full capacity of 180 array elements and | | | |
| (U) In FY 2005: Continue populating the high frequency transmitter 3.6 megawatt radiated output power. | array to its full capacity of 180 array elements and | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop basic seismic technologies to support explosions with special focus on monitoring regional events local | | 0.000 | 6.569 | 6.821 |
| (U) In FY 2003: Not Applicable. | acu al uistances less man 2,000 km nom me sensors. | | | |
| (U) In FY 2003: Not Applicable.(U) In FY 2004: Conduct seismic research such as seismic energy pa | artitions for local and regional events magnitudes | | | |
| and source physics; seismic calibration and ground truth collection | | | | |
| Project 1010 | R-1 Shopping List - Item No. 10-5 of 10-22 | | Exhibit R-2a (| PE (16(126()1E) |
| | 203 | | | - <u> </u> |

| Exhibit R-2a, RDT&E | Project Justification | DA | TE February 2 | 2004 |
|--|---|-------|--|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602601F Space Technology 1 | | JMBER AND TITLE The Survivability & Ce | k |
| discrimination technologies. Perform observational studies of seisn propagation characteristics of the Eurasian landmass. | nic wave propagation and collect seismic | | | |
| (U) In FY 2005: Provide updated seismic codes for operational use. Co | ontinue efforts on seismic energy partition, | | | |
| magnitudes, and source physics; seismic calibration; seismic detection | ion, location and discrimination; and observational | | | |
| studies of seismic wave propagation, including propagation in Eura | sia. Assess future direction of seismic research | | | |
| based on results obtained so far, and continue to conduct seismic re- | search on these and other topics of interest to the | | | |
| Air Force. | | | | |
| (U) | | | | |
| (U) CONGRESSIONAL ADD: Seismic Monitoring Research. | | 2.920 | 0.000 | 0.000 |
| (U) In FY 2003: Developed basic seismic technologies to support natio | | | | |
| explosions. Enhanced United States capabilities in seismic monitor | | | | |
| monitoring regional events located at distances less than 2,000 km f | | | | |
| experimental seismology studies to detect, locate, and characterize (U) In FY 2004: Not Applicable. | nuclear explosions. | | | |
| (U) In FY 2005: Not Applicable. | | | | |
| (U) | | | | |
| (U) CONGRESSIONAL ADD: High-frequency Active Auroral Resear | ch Program (HAARP) Incoherent Scatter Radar | 2.529 | 0.000 | 0.000 |
| (ISR). | | / | | |
| (U) In FY 2003: Developed a modular approach for installation of an I | SR diagnostic at the HAARP facility. Completed | | | |
| site infrastructure for the ISR and preliminary support structure. Ac | | | | |
| transmit/receive sub-array. Conducted a research program to characteristic charac | cterize radio-wave interactions and processes in | | | |
| the ionosphere using the sub-array as a powerful radar diagnostic in | strument in conjunction with the HAARP high | | | |
| power high frequency transmitting array. | | | | |
| (U) In FY 2004: Not Applicable. | | | | |
| (U) In FY 2005: Not Applicable. | | | | |
| | | 10.02 | 4.050 | 0.000 |
| (U) CONGRESSIONAL ADD: High-frequency Active Auroral Resear | | 4.963 | 4.958 | 0.000 |
| (U) In FY 2003: Develop the HAARP site transmitting and diagnostic management and environmental oversight. Performed research pro- | | | | |
| Extremely Low Frequency/Very Low Frequency waves generated i | | | | |
| Conducted research programs to characterize high power radio wav | | | | |
| including the generation of irregularities and optical emissions and | · · | | | |
| space weather specification. Developed real-time diagnostic and da | · · | | | |
| (U) In FY 2004: Develop planned diagnostic infrastructure at the HAA | | | | |
| | R-1 Shopping List - Item No. 10-6 of 10-22 | | Exhibit R-2a (F | PE 0602601F) |
| · · · · · · · · · · · · · · · · · · · | 204 | | | , |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DA | ^{⊤∈} February | / 2004 |
|---|---|--|--|--|--|-----------------|----------------|--|------------|
| BUDGET ACTIVITY 02 Applied Research | | | | PE NUMBER A 0602601F S | ND TITLE pace Technol | ogy 1 | | IMBER AND TITLE e Survivability ce | |
| environmental oversight functions. Frequency/Very Low Frequency ward detection of underground structures, (U) In FY 2005: Not Applicable. (U) (U) CONGRESSIONAL ADD: Electron (U) In FY 2003: Investigated, enhanced underground structures. Conducted using Very Low Frequency waves to algorithms, frequency agility, and retechniques to enhance the operationa (U) In FY 2004: Miniaturize a recently | ves in the ionosp and the reduction magnetic Gradico , and tested elect field demonstration detect undergradient mote data access al viability of bo | on of charged pa ometer Research tromagnetic rad tions of a miniat bund structures. s for unmanned th the man-port | applications to surficle population iometry technological ure and rugged Designed a sys aero vehicle/air able and airborn | ubsurface comm ns in the earth's r ogies for the dete man-portable ha tem with improv borne application e systems. | ection of rdware system red detection ns. Developed | | 1.945 | 2.082 | 0.000 |
| unmanned ground-based, randomly (U) In FY 2005: Not Applicable. | 1 00 | · • | • | | • | | | | |
| (U) Total Cost | | | | | | | 30.276 | 43.080 | 40.002 |
| (U) <u>C. Other Program Funding Sumn</u> | • | | | | | | | | |
| | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> | | Total Cost |
| (U) Related Activities: | <u>Actual</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimat</u> | <u>e</u> <u>Complete</u> | |
| PE 0305160F, Defense | | | | | | | | | |
| (U) Meteorological Satellite | | | | | | | | | |
| Program. | | | | | | | | | |
| (U) PE 0601102F, Defense Research | | | | | | | | | |
| Sciences. | | | | | | | | | |
| (U) PE 0602204F, Aerospace Sensors. | | | | | | | | | |
| PE 0305111F Weather | | | | | | | | | |
| (U) Systems. | | | | | | | | | |
| This project has been | | | | | | | | | |
| coordinated through the | | | | | | | | | |
| (U) Reliance process to harmonize efforts and eliminate | | | | | | | | | |
| duplication. | | | | | | | | | |
| - | | | | | | | | | |

| Exhibit R-2a. RI | DT&E Project Justification | DATE |
|---|--|--|
| BUDGET ACTIVITY | PE NUMBER AND TITLE | PROJECT NUMBER AND TITLE |
| 2 Applied Research | 0602601F Space Technology 1 | 1010 Space Survivability & Surveillance |
| U) <u>D. Acquisition Strategy</u> Not Applicable. | | |
| | | |
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| | | |
| | | |
| | | |
| | | |
| Project 1010 | R-1 Shopping List - Item No. 10-8 of 10-22 | Exhibit R-2a (PE 060260 |

| 02 Applied Research 060260 Cost (\$ in Millions) FY 2003 Actual FY 2004 Estimate FY 2005 Estimate FY 2005 Estimate FY 2005 4846 Spacecraft Payload Technologies 12.431 16.937 19.553 Estimate Quantity of RDT&E Articles 0 0 0 0 0 0 (U) A. Mission Description and Budget Item Justification This project develops advanced technologies that enhance spacecraft payload operations by in primary areas: (1) development of advanced, space-qualified, survivable electronics, and elect generation and exploitation technologies, including infrared, Fourier Transform hyperspectral (3) development of high-fidelity space simulation models that support space-based surveillanc (4) development of advanced networking, radio frequency, and laser communications technolo (U) B. Accomplishments/Planned Program (\$ in Millions) (U) MAJOR THRUST: Develop advanced infrared device technologies for space applications that focal plane detector arrays to enable acquisition, tracking, and discrimination of bodies such as warheads throughout their trajectory. (U) In FY 2003: Evaluated two- and three-color detector and continued development of multi-colo and broadband gratings. Designed and fabricated selected concepts for future longer waveleng and infrared detectors with optimal background-limited performance for stressing, low photon in backgrounds. Completed design study of next generation long and very long wavelength infrar including quantum wells and strained layer superlattice | ion | | | DATE | February | 2004 | | |
|--|--|---|---|--|--|-------------------------|--|--|
| Cost (S in Millions) Actual Estimate Estimate Estimate Estimate 4846 Spacecraft Payload Technologies 12.431 16.937 19.553 Quantity of RDT&E Articles 0 0 0 0 (U) A. Mission Description and Budget Item Justification This project develops advanced technologies that enhance spacecraft payload operations by in primary areas: (1) development of advanced, space-qualified, survivable electronics, and elect generation and exploitation technologies, including infrared, Fourier Transform hyperspectral (3) development of advanced networking, radio frequency, and laser communications technologies (4) development of advanced infrared device technologies for space-based surveillanc (4) development of advanced infrared device technologies for space applications that focal plane detector arrays to enable acquisition, tracking, and discrimination of bodies such as warheads throughout their trajectory. (U) In FY 2003: Evaluated two- and three-color detector and continued development of multi-colo and broadband gratings. Designed and fabricated selected concepts for future longer waveleng and infrared detectors with optimal background-limited performance for stressing, low photon in backgrounds. Completed design study of next generation long and very long wavelength infrar including quantum wells and strained layer superlattice, as lower cost, higher performance atte cadmium telluride. Evaluated delivered radiation-hardened cryogenic multiplexers for lower b infrared detector arrays. (U) In FY 2004: Fabricate and characterize strained-layer superla | | | | | | | | |
| 4846 Spacecraft Payload Technologies 12.431 16.937 19.553 Quantity of RDT&E Articles 0 | Y 2006 stimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total | | |
| Quantity of RDT&E Articles 0 0 0 (U) A. Mission Description and Budget Item Justification This project develops advanced technologies that enhance spacecraft payload operations by in primary areas: (1) development of advanced, space-qualified, survivable electronics, and elect generation and exploitation technologies, including infrared, Fourier Transform hyperspectral (3) development of high-fidelity space simulation models that support space-based surveillanc (4) development of advanced networking, radio frequency, and laser communications technolo (U) B. Accomplishments/Planned Program (% in Millions) (U) (U) MAJOR THRUST: Develop advanced infrared device technologies for space applications that focal plane detector arrays to enable acquisition, tracking, and discrimination of bodies such as warheads throughout their trajectory. (U) In FY 2003: Evaluated two- and three-color detector and continued development of multi-colo and broadband gratings. Designed and fabricated selected concepts for future longer waveleng and infrared detectors with optimal background-limited performance for stressing, low photon to backgrounds. Completed design study of next generation long and very long wavelength infrar including quantum wells and strained layer superlattices, as lower cost, higher performance alte cadmium telluride. Evaluated delivered radiation-hardened cryogenic multiplexers for lower b infrared detector arrays. (U) In FY 2004: Fabricate and characterize strained-layer superlattice detectors and use results to r improve absorption efficiency and eliminate manufacturing or operationally induced defects. C two-dimensional focal plane array development effort by identifying, desig | 20.608 | 20.735 | 35.740 | 39.529 | 0.000 | 0.000 | | |
| This project develops advanced technologies that enhance spacecraft payload operations by in primary areas: (1) development of advanced, space-qualified, survivable electronics, and elect generation and exploitation technologies, including infrared, Fourier Transform hyperspectral (3) development of high-fidelity space simulation models that support space-based surveillance (4) development of advanced networking, radio frequency, and laser communications technologies for advanced networking, radio frequency, and laser communications technologies (1) B. Accomplishments/Planned Program (\$ in Millions) (U) B. Accomplishments/Planned Program (\$ in Millions) (U) MAJOR THRUST: Develop advanced infrared device technologies for space applications that focal plane detector arrays to enable acquisition, tracking, and discrimination of bodies such as warheads throughout their trajectory. (U) In FY 2003: Evaluated two- and three-color detector and continued development of multi-colo and broadband gratings. Designed and fabricated selected concepts for future longer waveleng and infrared detectors with optimal background-limited performance for stressing, low photon is backgrounds. Completed design study of next generation long and very long wavelength infrare including quantum wells and strained layer superlattices, as lower cost, higher performance atte cadmium telluride. Evaluated delivered radiation-hardened cryogenic multiplexers for lower b infrared detector arrays. (U) In FY 2004: Fabricate and characterize strained-layer superlattice detectors and use results to r improve absorption efficiency and eliminate manufacturing or operationally induced defects. C two-dimensional focal plane array development effort by identifying, designing, and fabricating cryogenic detector multiplexers required for transitioning the technology. Begin development of adaptive, re-configurable, and polarimetric capabilities. (U) In FY 2005: Incorporate design changes into the fabric | 0 | 0 | 0 | 0 | | | | |
| (U) MAJOR THRUST: Develop advanced infrared device technologies for space applications that focal plane detector arrays to enable acquisition, tracking, and discrimination of bodies such as warheads throughout their trajectory. (U) In FY 2003: Evaluated two- and three-color detector and continued development of multi-colo and broadband gratings. Designed and fabricated selected concepts for future longer waveleng and infrared detectors with optimal background-limited performance for stressing, low photon is backgrounds. Completed design study of next generation long and very long wavelength infrare including quantum wells and strained layer superlattices, as lower cost, higher performance alter cadmium telluride. Evaluated delivered radiation-hardened cryogenic multiplexers for lower b infrared detector arrays. (U) In FY 2004: Fabricate and characterize strained-layer superlattice detectors and use results to r improve absorption efficiency and eliminate manufacturing or operationally induced defects. C two-dimensional focal plane array development effort by identifying, designing, and fabricating cryogenic detector multiplexers required for transitioning the technology. Begin development detector read-out circuit technologies for next generation surveillance systems with projected re adaptive, re-configurable, and polarimetric capabilities. (U) In FY 2005: Incorporate design changes into the fabrication process and continue wafer growth superlattice detector structures and other promising technologies. These alternatives to mercury offer both improved performance at a given operating temperature and comparable performance | ectronics pa al imaging nce and spa | ackaging techno , polarimetric s ace asset protec | ologies; (2) de ensing, and sa ction research | velopment of a tellite antenna and developme | dvanced space subsystem tech ent for the warfi | data nologies; | | |
| (U) In FY 2003: Evaluated two- and three-color detector and continued development of multi-color and broadband gratings. Designed and fabricated selected concepts for future longer waveleng and infrared detectors with optimal background-limited performance for stressing, low photon is backgrounds. Completed design study of next generation long and very long wavelength infrare including quantum wells and strained layer superlattices, as lower cost, higher performance alter cadmium telluride. Evaluated delivered radiation-hardened cryogenic multiplexers for lower be infrared detector arrays. (U) In FY 2004: Fabricate and characterize strained-layer superlattice detectors and use results to r improve absorption efficiency and eliminate manufacturing or operationally induced defects. Of two-dimensional focal plane array development effort by identifying, designing, and fabricating cryogenic detector multiplexers required for transitioning the technology. Begin development of adaptive, re-configurable, and polarimetric capabilities. (U) In FY 2005: Incorporate design changes into the fabrication process and continue wafer growth superlattice detector structures and other promising technologies. These alternatives to mercury offer both improved performance at a given operating temperature and comparable performance | | | | <u>2003</u> 3.518 | <u>FY 2004</u> 2.841 | <u>FY 2005</u> 4.083 | | |
| improve absorption efficiency and eliminate manufacturing or operationally induced defects. O two-dimensional focal plane array development effort by identifying, designing, and fabricating cryogenic detector multiplexers required for transitioning the technology. Begin development of detector read-out circuit technologies for next generation surveillance systems with projected readaptive, re-configurable, and polarimetric capabilities. (U) In FY 2005: Incorporate design changes into the fabrication process and continue wafer growth superlattice detector structures and other promising technologies. These alternatives to mercury offer both improved performance at a given operating temperature and comparable performance | ngth infrare n noise, an rared detec lternatives backgrour | ed detectors d space tor concepts, to mercury id, space | | | | | | |
| superlattice detector structures and other promising technologies. These alternatives to mercury offer both improved performance at a given operating temperature and comparable performance | Complete ing the app at of infrare requireme | the ropriate ed detector and nts for | | | | | | |
| temperatures. Evaluate promising "on-focal plane array polarimetric" concepts developed to m capability requirements of the next generation surveillance systems. | ry cadmiu | m telluride er operating | | | | | | |
| Project 4846 R-1 Shopping List - Item No. 10- | 10-9 of 10-22 | 2 | | | Exhibit R-2a (I | PE 0602601F) | | |

| | Exhibit R-2a, RDT&E Project Just | ification | D/ | February 2 | 004 |
|------------|---|--|-------|--|-----------|
| | DGET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602601F Space Technology 1 | | UMBER AND TITLE cecraft Payload gies | |
| (U) (U) | MAJOR THRUST: Develop spectral sensing and data exploitation methodologies for | military imaging and remote | 0.832 | 0.752 | 1.004 |
| (U) | sensing applications. In FY 2003: Assessed technology and modeling for understanding the electro-optical | - | | | |
| | phenomenology. Evaluated initial polarimetric signature model capability and validat Developed capability to integrate polarimetric models into modeling, simulation, and | | | | |
| (U) | surveillance applications. In FY 2004: Complete initial assessment of technology and modeling for understandi | • | | | |
| | spectral polarimetric phenomenology. Demonstrate partially validated polarimetric si continue validation with measured data from ongoing field collects. Integrate initial p | olarimetric models into | | | |
| (U) | modeling, simulation, and analysis architecture for space-based surveillance application In FY 2005: Complete assessment and documentation of electro-optical/infrared spec | | | | |
| | phenomenology understanding. Demonstrate validated polarimetric signature model upgrades and validation with measured data from on-going field collections. Demonst | | | | |
| (U) | polarimetric models into scene simulation architecture for space-based surveillance ap | pplications. | | | |
| · · · | MAJOR THRUST: Develop technologies for space-based payload components such radiation-hardened electronic devices, micro-electro-mechanical system (MEMS) dev | | 3.448 | 3.731 | 3.490 |
| | packaging for next generation high performance space electronics. | | | | |
| (U) | In FY 2003: Enhanced the switching speed and durability of the chalcogenide material devices through additional silicon-on-insulator radiation research. Extended the design of the speed of the design of the speed | | | | |
| | integrated low power, silicon-based quantum-sized devices to include non-traditional | - | | | |
| | the speed of the radiation-hardened nonvolatile digital memories. Characterized the a resolution to an eight-bit equivalent. Built space-qualified MEMS reliability test devi | • | | | |
| (ID | ground and flight insertion. Built reconfigurable analog array packaging structures. | silisen en insulaten somehins | | | |
| (0) | In FY 2004: Research radiation effects in electronics components based on emerging or other radio frequency and analog technology compatible substrates. Evaluate mono | | | | |
| | silicon-based quantum-sized devices for system-on-a-chip applications. Develop radi | ation hardening design | | | |
| | techniques to enable fabrication of electronics on commercial lines. Evaluate architect analog memory. Build micro-electro-mechanical system based switches supporting c | | | | |
| | support of self-adaptable spacecraft hardware. Develop architectures and packaging a | | | | |
| an | reconfigurable space systems. In FY 2005: Research radiation effects in electronics built with hardness by design m | ethods at state-of-the-art | | | |
| (0) | manufacturing plants. Evaluate chalcogenide-based reconfigurable electronics provid | | | | |
| Pro | pject 4846 R-1 Shopping List - Ite | • | | Exhibit R-2a (PE | 0602601F) |
| | | 08 | | | |

| | Exhibit R-2a, RDT&E Project J | ustification | DAT | February 2 | 2004 |
|--|--|--|-------|---|-------------|
| BUDGET ACTIV 02 Applied I | | PE NUMBER AND TITLE 0602601F Space Technology 1 | | MBER AND TITLE ecraft Payload ies | |
| devices f ten-fold self-adap | ment and self-repair capabilities. Build monolithically integrated low-po- for system-on-a-chip applications. Establish tools for hardness-by-design decrease in manufacturing cost. Design switches on chip, board, and intro- table, self-healing spacecraft hardware. Develop and evaluate architectu- of reconfigurable space systems. | n part manufacture and demonstrate ra-board level supporting | | | |
| (U) MAJOR | THRUST: Develop modeling, simulation, and analysis tools for space-bous and proximity operations, optical/infrared imaging space systems, and | - | 2.347 | 1.255 | 2.874 |
| (U) In FY 20 including | 003: Extended simulation architecture to support flight experiment grour g spacecraft bus and payload modeling development. The simulation arc of-systems assessment. | | | | |
| (U) In FY 20 Extend th simulation | 04: Further extend simulation architecture to support flight experiment the architecture for use in objective system-of-systems, military utility as on architecture to address missions associated with responsive space, spa pace. Develop enhancements to optical/infrared imaging system simulat | sessment. Develop extensions to the ce capability protection, and | | | |
| (U) In FY 20 experime responsiv associate | 005: Ready the simulation architecture to support flight experiment simulation on deployable antenna technology, adaptive avionics, autonomous cover space technologies. Continue to develop extensions to the simulation and with responsive space, space capability protection, and counterspace. | lation and data validation for ommand/control software, and architecture to address missions | | | |
| (U) | | | | | |
| | THRUST: Develop advanced architectures and performance characteriz ght, modular space antennas. | zation tools for future large, | 0.924 | 0.957 | 0.870 |
| phased a advanced control to | 03: Extended antenna architecture and algorithms developed for perform rray antenna tiles to multi-beam, wider-bandwidth, multi-mode operation d low-power, low-noise amplifiers, integrated wide-bandwidth radiators, echnologies. Built a testbed to simulate performance of multi-beam, wide integrated antenna models. | n. Supported development of and active radio frequency manifold | | | |
| (U) In FY 20 integrate radiators prediction | 004: Refine transmit/receive testbed, enhancing the performance of the p d antenna modules using miniaturized active radio frequency component . Characterize performance of new wide-bandwidth antenna subsystems ons; update models based on actual performance. Develop algorithms for poperating apertures and for advanced antenna array calibration. | ts and planar wide-bandwidth and correlate results to model | | | |
| Project 4846 | R-1 Shopping Lis | st - Item No. 10-11 of 10-22 | | Exhibit R-2a (P | E 0602601F) |
| | | 209 | | | |

| Exhibit R-2a, RDT&E Project Justification | | D | | 2004 |
|--|------------------------------------|----------|---|--------------|
| | R AND TITLE Space Technology 1 | 4846 Spa | DATE February 2 PROJECT NUMBER AND TITLE 4846 Spacecraft Payload Technologies 0.000 1.872 0.000 3.744 | |
| (U) In FY 2005: Investigate subsystems architectures for sparse membrane arrays for next generation and a smart antenna that extends transmit/receive antenna technology to autonomous beam control and characterize performance of autonomous beam control subsystem. Correlate results to model update models based on actual performance. | ol. Design, fabricate, | | | |
| (U) (U) MAJOR THRUST: Develop bandwidth efficient modulation and high bandwidth communication support next generation satellite communication systems. | as technologies to | 0.000 | 1.872 | 1.790 |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Explore architecture studies and guide technology investment in support of satellite roadmap. Develop technology standards and system designs for integrating multiple airborne integrating surveillance, and reconnaissance assets into single space platforms. | | | | |
| (U) In FY 2005: Further explore architecture studies and guide technology investment in support of s communications roadmap. Expand development of technology standards and system designs for airborne intelligence, surveillance, and reconnaissance assets into single space platforms. | | | | |
| (U) (U) MAJOR THRUST: Develop technologies for multi-access laser communications terminals. Assessingle access terminal components and their applicability to a multi-access terminal design. | ess the maturity of | 0.000 | 3.744 | 5.442 |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop standards for combining multiple airborne intelligence, surveillance, and respace asset feeds into a single optical data path. Design a laboratory multi-access terminal testbere (U) In FY 2005: Further develop standards for combining multiple airborne intelligence, surveillance reconnaissance and space asset feeds into a single optical data path. Continue design of a laboratory | d. ., and | | | |
| terminal testbed. | | | | |
| (U) (U) CONGRESSIONAL ADD: Mixed Signal Very Large Scale Integrated (VLSI) [Circuits] for Space Communication Subsystems. | ce Vehicle | 1.362 | 1.785 | 0.000 |
| (U) In FY 2003: Developed radiation-hard analog circuit elements for mixed signal VLSI circuits for high-bandwidth intra-satellite and satellite-ground station communications. Radiation tested and commercial state-of-the-art mixed signal components to determine the feasibility of employing co technologies for space applications. Designed and fabricated innovative circuit configurations an new radiation-hard analog elements and circuit architectures. | characterized ommercial foundry | | | |
| (U) In FY 2004: Develop improved, radiation-hard, analog circuit elements for mixed-signal VLSI ci employ results from radiation testing and characterization of commercial state-of-the-art mixed-si improve designs using commercial foundry technologies for space applications. Design and fabri | gnal components to | | | |
| Project 4846 R-1 Shopping List - Item No. 10-12 | | | Exhibit R-2a (I | PE 0602601E) |

| | Exhibit R- | 2a, RDT&E | | stification | | | DATE | February | 2004 |
|---|--|-----------------------------|--------------------------|----------------------------|---|---------------------|---------------------|---------------------|-------------------|
| BUDGET ACTIVITY D2 Applied Research | | PE NUMBER A 0602601F S | ND TITLE pace Technol | ogy 1 | PROJECT NUMBER AND TITLE 4846 Spacecraft Payload Technologies | | | | |
| circuit configurations and test deviU) In FY 2005: Not Applicable.U) Total Cost | ces using new rad | liation-hard anal | og elements and | l circuit architect | tures. | | 12.431 | 16.937 | 19.553 |
| U) C. Other Program Funding Sum U) Related Activities: PE 0603401F, Advanced Spacecraft Technology. This project has been coordinated through the U) Reliance process to harmonize efforts and eliminate duplication. U) D. Acquisition Strategy Not Applicable. | mary (\$ in Milli <u>FY 2003</u> <u>Actual</u> | ons) FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | <u>Total Cost</u> |
| Project 4846 | | R- | | Item No. 10-13 of 1 211 | 10-22 | | | Exhibit R-2a | (PE 0602601 |

| BUDGET ACTIVITY 02 Applied Research PR JUDBER AND TITLE 10602601F Space Technology 1 PR JUDBER AND TITLE 10602601F Space Technology 1 PR JUDBER AND TITLE 0018 PR JUDBER AND TITLE 0018 PR JUDBER AND TITLE 10000 PR JUDBER AND TITLE 0018 PR JUDBER AND TITLE 0010 OP JUDBER AND TITLE 0010 OP JUDBER AND TITLE 0010 Output L PR JUDBER AND TITLE 0010 Output L PR JUDBER AND TITLE 0010000 PR JUDBER AND TITLE 0010000000000000000000000000000000000 | | Exi | hibit R-2a, I | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|--|-------------------|---|--|---|--------------------------------------|---------------------------|-----------------|-------------------------------|------------------|-----------------------------------|--------------|
| Cost (s in Millions) Actual Estimate Estimate Estimate Estimate Estimate Complete 3018 Spacecraft Protection Technology 4.355 4.011 2.630 2.434 2.516 0.000 0.000 Quantity of RDT&E Articles 0 | | | | | | | | gy 1 | 5018 Spacec | | n |
| Actual Estimate Estimate <thestimate< th=""> Estimate <t< th=""><th></th><th>Cost (\$ in Millions)</th><th>FY 2003</th><th>FY 2004</th><th>FY 2005</th><th>FY 2006</th><th>FY 2007</th><th>FY 2008</th><th>FY 2009</th><th>Cost to</th><th>Total</th></t<></thestimate<> | | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| Quantity of RDT&E Articles 0 </td <td></td> <td>Cost (\$ III Millions)</td> <td>Actual</td> <td>Estimate</td> <td>Estimate</td> <td>Estimate</td> <td>Estimate</td> <td>Estimate</td> <td>Estimate</td> <td>Complete</td> <td></td> | | Cost (\$ III Millions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| Note: In FY 2003, Project 1010 was split with efforts focused on protecting spacecraft from mammade threats being transferred into Project 5018. (U) A.Mission Description and Budget Item Justification This project develops the technologies for protecting U.S. space assets in potential hostile environments to assure continued space system operation without performance loss in support of warfighter requirements. The project focuses on identifying and assessing spacecraft system vulnerabilities, developing threat warning technologies, and developing technologies to mitigate the effects of both intentional and unintentional threats. (U) B.Accomplishments/Planned Program (S in Millions) FY 2003 FY 2004 FY 2005 (U) MAJOR THRUST: Develop key satellite threat warning technologies and tools for high value satellite asset defense. 0.943 1.285 0.911 (U) In FY 2004 per 2005 intig commons of a high performance multiple threat sensors satellite protection system, improving technical performance of the sensor suite while still minimizing cost, power, and weight. Investigated integration of the miniature radio frequency (RF) geolocation from a low-earth-orbit satellite. Investigated laser and RF false alarm rejection/mitigation and anomaly resolution and management techniques. 0.943 1.285 0.911 (U) In FY 2004 per 2005 information/mitigation and anomaly resolution and management techniques. 0.943 1.285 0.911 (U) In FY 2004 | 5018 | | | | | 2.442 | 2.303 | 2.434 | 2.516 | 0.000 | 0.000 |
| (I) A.Mission Description and Budget Item Justification This project develops the technologies for protecting U.S. space assets in potential hostile environments to assure continued space system operation without performance loss in support of warfighter requirements. The project focuses on identifying and assessing spacecraft system vulnerabilities, developing the technologies to mitigate the effects of both intentional and unintentional threats. (I) B. Accomplishments/Planned Program (S in Millions) (I) MAJOR THRUST: Develop key satellite threat warning technologies and tools for high value satellite asset defense. (I) MAJOR THRUST: Develop key satellite threat warning technologies on alow-earth-orbit satellite. Investigated integration of the miniature radio frequency receiver, laser detector, and ionosphere specification system with advanced reconfigurable processor electronics for the first generation system. Assessed feasibility of using a single antenna for performing radio frequency (RF) geolocation from a low-earth-orbit satellite. Investigated laser and RF false alarm rejection/mitigation and anomaly resolution and management techniques. (I) In FY 2004: Develop and bench-test high performance multi-threat warning on-board sensors. Explore reconfigurable processor electronics capability and build testbed in support of multi-threat warning sensors. Analyze light, adaptable single antenna performance. (II) In FY 2005: Update microsatellite threat characteristics. Select most promising proximity sensor technology and begin development of a experimental proximity sensor. Design and report ground and space demonstration plan for the purpose of confirming radio frequency RF every selection and performed post-experiment data and system performance analysis. (II) In FY 2005: Update microsatellite threat capabilitys and proximity sensor technology and begin development of a experimental paroximity sensor performance. (II) In FY 2005: Cupdat | | | Ŷ | ÷ | Ĵ | Ŭ Ŭ | ů | ů | Ŷ | | |
| (U) In FY 2003: Developed initial components of a high performance multiple threat sensors satellite protection system, improving technical performance of the sensor suite while still minimizing cost, power, and weight. Investigated integration of the miniature radio frequency receiver, laser detector, and ionospheric specification system with advanced reconfigurable processor electronics for the first generation system. Assessed feasibility of using a single antenna for performing radio frequency (RF) geolocation from a low-earth-orbit satellite. Investigated laser and RF false alarm rejection/mitigation and anomaly resolution and management techniques. (U) In FY 2004: Develop and bench-test high performance multi-threat warning on-board sensors. Explore reconfigurable processor electronics capability and built testbed in support of multi-threat warning sensors. Analyze light, adaptable single antenna performance for threat detection and geolocation applications. Complete false alarm research for relevant threats. Select antenna technology for wide-band and narrow-band threat detectors for multi-threat appaility space experiment. (U) In FY 2005: Update microsatellite threat characteristics. Select most promising proximity sensor technology and begin development of a experimental proximity sensor. Design and report ground and space demonstration plan for the purpose of confirming proximity sensor performance. (U) MAJOR THRUST: Develop high value space asset defensive capabilities. (U) In FY 2003: Conducted threat reporting risk reduction Space Shuttle experiment and performed post-experiment data and system performance analysis. (U) In FY 2005: Select most promising defensive weapon technology and begin development of experimental defensive | (U) | This project develops the technologies for loss in support of warfighter requirements developing technologies to mitigate the ef B. Accomplishments/Planned Program (| r protecting U.S s. The project for ffects of both in (\$ in Millions) | b. space assets in ocuses on iden tentional and t | tifying and asso inintentional th | essing spacecra reats. | ft system vulne | rabilities, deve <u>FY</u> | eloping threat w | erning technolo <u>FY 2004</u> | ogies, and |
| (U) MAJOR THRUST: Develop high value space asset defensive capabilities. (U) In FY 2003: Conducted threat reporting risk reduction Space Shuttle experiment and performed post-experiment data and system performance analysis. (U) In FY 2004: Design and fabricate miniaturized narrowband RF attack reporting receiver with of goal of five times reduction in power and size. (U) In FY 2005: Select most promising defensive weapon technology and begin development of experimental defensive | (U) (U) (U) | MAJOR THRUST: Develop key satellite threat warning technologies and tools for high value satellite asset defense. 0.943 1.285 0.911 In FY 2003: Developed initial components of a high performance multiple threat sensors satellite protection system, improving technical performance of the sensor suite while still minimizing cost, power, and weight. Investigated integration of the miniature radio frequency receiver, laser detector, and ionospheric specification system with advanced reconfigurable processor electronics for the first generation system. Assessed feasibility of using a single antenna for performing radio frequency (RF) geolocation from a low-earth-orbit satellite. Investigated laser and RF false alarm rejection/mitigation and anomaly resolution and management techniques. J In FY 2004: Develop and bench-test high performance multi-threat warning on-board sensors. Explore reconfigurable single antenna performance for threat detection and geolocation applications. Complete false alarm research for relevant threats. Select antenna technology for wide-band and narrow-band threat detectors for multi-threat capability space experiment. J In FY 2005: Update microsatellite threat characteristics. Select most promising proximity sensor technology and begin development of a experimental proximity sensor. Design and report ground and space demonstration plan for | | | | | | | | | |
| Project 5018 R-1 Shopping List - Item No. 10-14 of 10-22 Exhibit R-2a (PE 0602601F) | (U) (U) (U) | In FY 2003: Conducted threat reporting ri and system performance analysis. In FY 2004: Design and fabricate miniatur reduction in power and size. | sk reduction Sp | ace Shuttle exp nd RF attack re | periment and perporting receive | er with of goal c | of five times | | 1.314 | 0.847 | 0.601 |
| | Pro | ect 5018 | | R-1 Sh | opping List - Item | No. 10-14 of 10- | 22 | | | Exhibit R-2a (I | PE 0602601F) |

| PE NUMBER AND TITLE D602601F Space Technology 1 apabilities. Design and report ground and space demonstration plan for the purpose of confirming defensive apability performance. MAJOR THRUST: Develop techniques to exploit existing on-board inherent satellite resources, satellite-as-a-sensor, and calf another particulate techniques to exploit existing on-board inherent satellite resources, satellite-as-a-sensor, and calf another particulate techniques to exploit existing on-board inherent satellite resources, satellite-as-a-sensor, | | February JMBER AND TITLE ecraft Protectio Jy 0.831 | |
|--|-------|--|--------------|
| apability performance. IAJOR THRUST: Develop techniques to exploit existing on-board inherent satellite resources, satellite-as-a-sensor, | 0.347 | 0.831 | |
| AJOR THRUST: Develop techniques to exploit existing on-board inherent satellite resources, satellite-as-a-sensor, | 0.347 | 0.831 | |
| | 0.347 | 0.831 | |
| nd self aware satellite technologies as a first-line threat detection system. | | 0.051 | 0.590 |
| n FY 2003: Investigated use of systems on currently fielded or launch ready satellites for preliminary determination f radio frequency/laser illumination or kinetic impact. Assessed the use of telemetry, state-of-health data, and other ppropriate data for event determination. | | | |
| a FY 2004: Develop technology for currently fielded or launch-ready satellites to detect anomalies that result from adio frequency/laser illumination or kinetic impact. Explore use of on board resources such as telemetry or tate-of-health data for anomaly determination as a zero added power/weight solution and assess the limits of this echnique. Conduct laboratory proof of concept for selected subsystems. | | | |
| n FY 2005: Conduct ground simulation demonstration of a combined satellite-as-a-sensor system. The simulation includes data fusion, unique radio frequency location tool, simulated laser sensor, simulated proximity sensor, and atellite as a sensor test bed. | | | |
| | | | |
| IAJOR THRUST: Develop techniques for monitoring and assessing electromagnetic interference and compatibility | 1.751 | 1.048 | 0.528 |
| etween ultra-sensitive payload sensors for space systems that support space weather forecasting. | | | |
| n FY 2003: Integrated payload for the Communications/Navigation Outage Forecast System (C/NOFS) Advanced | | | |
| Concept Technology Demonstration. Designed, developed, and tested serial communications hardware and software | | | |
| or command and data handling spacecraft sub-system risk reduction for real-time space weather forecasting. | | | |
| alidated data compression techniques with payload sensor data and apply to space flight software for demonstrating pace weather forecasting. | | | |
| a FY 2004: Continued to prepare for the space experiment demonstration of C/NOFS. | | | |
| 1 FY 2005: Conduct space experiment demonstration of C/NOFS. Perform measurements of key ionospheric and | | | |
| cintillation parameters needed for input to ionospheric specification and forecast models. Assess data for | | | |
| lectromagnetic interference effects on ultra-sensitive payload sensors. Assess payload performance in measuring | | | |
| phospheric and scintillation parameters needed for space weather support in theater and for mission planners and | | | |
| ther users. | | | |
| Total Cost | 4.355 | 4.011 | 2.630 |
| | | | |
| ct 5018 R-1 Shopping List - Item No. 10-15 of 10-22 | | Exhibit R-2a (I | PE 0602601F) |

| Exhibit R-2a, RDT&E | E Project Justification | | February 2004 |
|---|--|---|------------------------|
| UDGET ACTIVITY 2 Applied Research | PE NUMBER AND TITLE 0602601F Space Technology 1 | PROJECT NUMBER AND TITLE 5018 Spacecraft Protect Technology | |
| J) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | | |
| U) D. Acquisition Strategy Not Applicable. | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| Project 5018 | R-1 Shopping List - Item No. 10-16 of 10-22 | | Exhibit R-2a (PE 06026 |

| | ExI | hibit R-2a, F | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 | |
|-------------------|---|--|--|---|--|---|----------------------------------|-----------------------------------|---|-------------------------|--|
| | ET ACTIVITY pplied Research | | | | PE NUMBER AND 0602601F Spa | | gy 1 | | OJECT NUMBER AND TITLE 09 Spacecraft Vehicle chnologies | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | |
| 8809 | | 27.827 | 37.511 | 26.724 | 27.128 | 32.411 | 39.954 | | 0.000 | 0.000 | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| (U) | A. Mission Description and Budget Iter This project focuses on seven major space survivable electronics); satellite control (c space-based systems; satellite protection t and integrated experiments of advanced to | e technology are e.g., software fo technologies (e.g | r autonomous (g., space enviro | distributed sate onment effects | ellite formation t | flying, signal p on, and threat v | rocessing, and varning/attack | control); mode reporting); mic | ling and simula | tion of | |
| | B. Accomplishments/Planned Program (MAJOR THRUST: Develop technologies | | bace platform s | subsystems suc | h as cryocoolers | s, compact, | <u>F</u> Y | <u>7 2003</u> 3.240 | <u>FY 2004</u> 3.871 | <u>FY 2005</u> 4.188 | |
| (U) (U) (U) | high efficiency solar power cells and array In FY 2003: Improved accuracy of cryoco operational life and degrade cryocooler sub Proved production capacity for a 10% effic In FY 2004: Complete identification of me performance and reliability. Build first gen measurements, and thermophysical fluid fl performance. Investigate technology deve and recuperative cycle cryocoolers. Fabric lower-cost silicon wafers with efficiencies 28% Germanium solar cells. Demonstrate In FY 2005: Build second-generation emp regenerators. Further investigate technology regenerative and recuperative cycle cryoco thermodynamic cycle coolers. Develop a 3 technology. Fabricate 10% efficient thin-f | oler modeling to system perform cient thin-film so echanical and lo neration analytic ow and heat tra- lopment to impre- tate multijunction that break even 10% efficient the pirically verified ogy development olers. Build mo 30% efficient cr | bols and the id nance. Fabrica blar cell. ng-term failure cal performance ove cryocoole on solar cells us with the effici- nin-film solar con- thermophysica to improve co- odeling and sin ystalline multi- | entification of ted and tested e mechanisms be prediction m or low-tempera r capability and sing lattice-mis ency of curren cells on polyme al performance ryocooler capa nulation capabi junction solar of | mechanisms that a 32% efficient for assessing cry odels, empirical ture cryocooler d performance f smatch technolo t production mu er substrates. e models for cry ibility and perfo | solar cell. yocooler regenerator or regenerative gy on ltijunction ocooler rmance for x | | | | | |
| (U) | MAJOR THRUST: Develop technologies vibration suppression, multifunctional stru- satellite and launch vehicle structures. In FY 2003: Flight tested full-spacecraft v | ctures, deployab | le large apertu | re optical array | ys, and lightwei | ght composite | | 7.576 | 9.500 | 7.274 | |
| | ect 8809 | | | | n No. 10-17 of 10-2 | | | | Exhibit R-2a (I | PE 0602601F) | |
| · · · · · · | | | | 01/ | | | | | | | |

| | Exhibit R-2a, RDT&E Project | Justification | DAT | February | 2004 |
|------|--|---|--|-----------------|--------------|
| | GET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602601F Space Technology 1 | PROJECT NUMBER AND TI 8809 Spacecraft Vehic Technologies | | |
| | launch vehicle environment. Potential to decrease vibration and acoustic stress overall cost of spacecraft design. Characterized performance of multifunctional In FY 2004: Complete characterization of multifunctional small spacecraft bus nanotechnology-enhanced lightweight space structures. Develop lightweight st controls for large-aperture space optics. Develop low-shock and precision depli In FY 2005: Perform material characterization of tunable nanotechnology-enha Fabricate and test engineering concepts for lightweight structures and precision space optics. Fabricate and test low-shock and precision deployment mechanism subsystem deployment. | al bus structure for small spacecraft. . Initiate development of tunable ructures and precision structural oyment mechanisms. anced lightweight space structures. structural controls for large-aperture | | | |
| (U) | subsystem deptoyment. | | | | |
| (U) | MAJOR THRUST: Develop microsatellite (10-100kg) technologies and integra concepts. The innovative microsatellite architectures and advanced satellite bus applications such as space protection, counterspace capabilities, sparse aperture inter-satellite communications, distributed processing, and responsive payloads | s technologies could enable sensing, on-orbit formation flying, | 9.944 | 4.641 | 2.106 |
| (U) | In FY 2003: Completed fabrication and qualification testing of subsystem hard thrusters, and high-density memory. Completed fabrication and environmental detailed studies for potential new mission payloads. | • | | | |
| (U) | In FY 2004: Note: The planned microsatellite technology program was re-orie techniques to evaluate the technical feasibility, military utility, and cost effectiv meet future space-based radio frequency intelligence, surveillance, and reconna | reness of a multi-aperture system to | | | |
| (U) | In FY 2005: Plan to complete evaluation of the technical feasibility, military ut | | | | |
| | multi-aperture system to meet future space-based radio frequency intelligence, s | surveillance and reconnaissance needs. | | | |
| (U) | MAJOR THRUST: Develop flight experiments to address key scientific and te | abaological problems in order to | 0.000 | 7.303 | 13.156 |
| | improve the capabilities of existing operational space systems and to enable new | | 0.000 | 7.505 | 15.150 |
| | In FY 2003: Not Applicable. In FY 2004: Evaluate structures, controls, and isolation technologies for maturity | ity for space flight experiments | | | |
| (0) | Design and develop a deployable structures space flight experiment for potentia Develop initial efficient, large, deployable antennas for space-borne sensors for initial designs for deployable thin film photovoltaic arrays suitable for middle-e | Il space-based radar applications. radiation belt remediation. Start | | | |
| (U) | In FY 2005: Complete design of a deployable structures space flight experiment | nt for potential space-based radar | | | |
| | applications. Integrate lightweight deployable structures with efficient, large, d | | | | |
| (U) | sensors and deployable thin film photovoltaic arrays for midele-earth orbit fligh | it experiment of these technologies. | | | |
| l` í | ject 8809 R-1 Shopping I | List - Item No. 10-18 of 10-22 | | Exhibit R-2a (F | PE 0602601F) |
| | , | 216 | | | |

| | Exhibit R-2a, RDT&E Proj | DA | TE February 2 | 004 | |
|--|--|---|------------------|--|-------------|
| BUDGET ACTIVITY 02 Applied Resea | ırch | PE NUMBER AND TITLE 0602601F Space Technology 1 | | JMBER AND TITLE cecraft Vehicle gies | |
| (U) In FY 2003: E mirror fabricat support sensor expensive, and fabrication tech (U) In FY 2004: N (U) In FY 2005: N | ** | he associated structural systems required to ntensive, and the product is heavy, ed non-traditional and innovative composite | 0.975 | 0.000 | 0.000 |
| (U) In FY 2003: D requirements of and types for u | | systems and assessed carbon foam blends hose systems. Downselected to the optimal | 0.448 | 0.000 | 0.000 |
| (U) (U) CONGRESSIO (U) In FY 2003: C navigation syst distributed ape (U) In FY 2004: D microsatellite I | DNAL ADD: Technology Satellite of the 21st Century (Tec Completed integration and test of microsatellite system flight tem with live Global Positioning Signals to support potentia rture formations to space surveillance, threat warning, and p Develop and ground test advanced subsystem flight units that bus technologies. Key advances in microsatellite bus technologies. | t software. Evaluated performance of flight l mission applications ranging from protection. t could demonstrate responsive plogies include high power density lithium | 2.920 | 2.975 | 0.000 |
| mass memory applications ra (U) In FY 2005: N (U) (U) CONGRESSIO | ONAL ADD: Substrates for Solar Cells. | t program could support mission ance, threat warning, and protection. | 1.362 | 1.190 | 0.000 |
| film solar array stowed volume Copper-Indiun | Developed high temperature polymer substrates for thin film ys. These thin film arrays will be three to five times lighter, e, and be more radiation resistant than state-of-the-art rigid p n-Gallium-DiSelenide (CIGS) thin film solar cells do not sur abricating the highest efficiency solar cells. Developed, fab R-1 Shop | cost five times less, require five times less panel arrays. Current polymer substrates for rvive the high temperature processing pricated, and tested high temperature pping List - Item No. 10-19 of 10-22 | | Exhibit R-2a (PE | E 0602601F) |
| | | 217 | | | |

| Exhibit R-2a, RDT&E F | Exhibit R-2a, RDT&E Project Justification | | | | | | | | |
|--|--|---------------------------------------|-----------------|-------|--|--|--|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602601F Space Technology 1 | PROJECT NU 8809 Space Technolog | 2004 | | | | | | |
| silicone resin films suitable for CIGS thin film solar cell substrates. D on the high temperature polymers. (U) In FY 2004: Further the development of silicone resin high temperature Copper-Indium-Gallium-DiSelenide (CIGS) thin film solar cells for mand develop monolithic integration of Copper-Indium-Gallium-DiSelenide Manufacture and the solar cells and the solar cells for mand the solar cells for mandevelop monolithic integration of Copper-Indium-Gallium-DiSelenide (CIGS) thin film solar cells for mandevelop monolithic integration of Copper-Indium-Gallium-Diselenide (CIGS) thin film solar cells for mandevelop monolithic integration of Copper-Indium-Gallium-Diselenide (CIGS) the solar cells for mandevelop monolithic integration of Copper-Indium-Gallium-Diselenide (CIGS) the solar cells for mandevelop monolithic integration of Copper-Indium-Gallium-Diselenide (CIGS) the solar cells for mandevelop monolithic integration of Copper-Indium-Gallium-Diselenide (CIGS) the solar cells for mandevelop monolithic integration of Copper-Indium-Gallium-Diselenide (CIGS) the solar cells for mandevelop monolithic integration of Copper-Indium-Gallium-Diselenide (CIGS) the solar cells for mandevelop monolithic integration of Copper-Indium-Gallium-Diselenide (CIGS) the solar cells for mandevelop monolithic integration (CIGS) the solar cells for mandevelop monolithic integration (CIGS) the solar cells for mandevelop monolithic integration (CIGS) the solar cells for mandevelop monolithic (CIGS) the solar cells for mandevelop monolith | are polymer substrates for ext-generation flexible, thin film solar arrays enide (CIGS) solar cells on these substrates. | | | | | | | | |
| Monolithic integration, which is enabled by these non-conductive sub- interconnection of individual cells into solar arrays. Demonstrate the free-standing high temperature polymers and demonstrate large area n (U) In FY 2005: Not Applicable. (U) | roll-to-roll deposition of CIGS solar cells on | | | | | | | | |
| (U) CONGRESSIONAL ADD: Integrated Control for Autonomous Space (U) In FY 2003: Developed advanced attitude and dynamic control technologies provide unprecedented levels of control over dynamic su tracking. Designed an integrated controls architecture, which includes sensors, and real-time system identification software that can character space platforms. | ologies for next generation spacecraft. These absystem response, precision pointing and target s flight computer, an advanced suite of dynamic | 1.362 | 0.992 | 0.000 | | | | | |
| (U) In FY 2004: Develop advanced attitude and dynamic control technoloc unprecedented levels of control over dynamic subsystem response, pre- the engineering models of integrated controls architecture designs, initi incorporate the engineering models into a spacecraft design. (U) In FY 2005: Not Applicable. | ecision pointing, and target tracking. Fabricate | | | | | | | | |
| (U) (U) CONGRESSIONAL ADD: Elastic Memory Composites and Elastic I (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop elastic memory composite material technologie component utility. These composite materials have unique properties | s for unconventional approaches in satellite | 0.000 | 3.272 | 0.000 | | | | | |
| spacecraft components and to enhance existing components. Design, hinge hardware for possible on-orbit demonstration. Design and build as the primary attitude-stabilizing element for a satellite. Design and a deployment mechanism. (U) In FY 2005: Not Applicable. | a composite deploying gravity gradient boom | | | | | | | | |
| (U) (U) CONGRESSIONAL ADD: Converted Silicon Carbide for High Perfect (U) In FY 2003: Not Applicable. | ormance Optic Structures. | 0.000 | 1.487 | 0.000 | | | | | |
| | | | Exhibit R-2a (F | | | | | | |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | Γ | Februar | / 2004 |
|--------------------------|---|--|---|---|--|---|---------------------|-----------------------|----------------------------|---------------|
| | GET ACTIVITY Applied Research | | | | PE NUMBER A 0602601F S | ND TITLE pace Technol | ogy 1 | | NUMBER AND TITLI | |
| (U) (U) (U) (U) | In FY 2004: Explore the application fabrication of large, lightweight, sputhe potential cost, fabricating speed In FY 2005: Not Applicable. CONGRESSIONAL ADD: Afford In FY 2003: Not Applicable. In FY 2004: Develop a process for of multi-junction solar cells on all I entire cell. Develop a domestic sour including demonstration of a crysta production scale-up plan. The benc | ace optics. Desig , and performanc lable Multi-Junct affordable produ Department of De urce of Ge wafers l growth and waf ch operation will | gn, analyze, fabr e of mirrors fab ion Solar Cells. action of single of efense satellites, encompassing to fer fabrication ca | icate, and test a ricated from sili crystal Germania comprising app the establishmen apability, a plan | silicone carbide con carbide. um (Ge) wafers, roximately half t it of a pilot/benc to recycle Ge ma | mirror. Assess a key componer he cost of the h operation, etal, and a | | 0.000 | 2.280 | 0.000 |
| | the establishment of quality control | procedures. | | | | | | | | |
| | In FY 2005: Not Applicable. Total Cost | | | | | | | 27.827 | 37.511 | 26.724 |
| , , | | | | | | | | 21.021 | 57.511 | 20.724 |
| (U) | C. Other Program Funding Sum | • | | EX 2005 | | EV 2007 | FX 2000 | EX 20 | | |
| | | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | <u>FY 2006</u> Estimate | <u>FY 2007</u> Estimate | FY 2008 Estimate | <u>FY 20</u> Estim | | Total Cost |
| (U) | Related Activities: | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | LStill | <u>ate</u> <u>complete</u> | 1 |
| (U) | PE 0602203F, Aerospace | | | | | | | | | |
| (0) | Propulsion. | | | | | | | | | |
| (U) | PE 0602102F, Materials. | | | | | | | | | |
| (U) | PE 0603311F, Ballistic Missile Technology. | | | | | | | | | |
| | PE 0603401F, Advanced | | | | | | | | | |
| (U) | Spacecraft Technology. | | | | | | | | | |
| | PE 0603500F, | | | | | | | | | |
| (U) | Multi-Disciplinary Advanced | | | | | | | | | |
| | Development Space Technology. | | | | | | | | | |
| | This project has been | | | | | | | | | |
| (U) | coordinated through the | | | | | | | | | |
| | Reliance process to harmonize | | | | | | | | | |
| 4 | ject 8809 | | | 1 Shopping List - | | | | | | (PE 0602601F) |

| | | DATE |
|--|--|---|
| | E Project Justification | February 2004 |
| BUDGET ACTIVITY D2 Applied Research | PE NUMBER AND TITLE 0602601F Space Technology 1 | PROJECT NUMBER AND TITLE 8809 Spacecraft Vehicle Technologies |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> efforts and eliminate duplication. | | |
| U) D. Acquisition Strategy Not Applicable. | | |
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| Project 8809 | R-1 Shopping List - Item No. 10-22 of 10-22 | Exhibit R-2a (PE 060260 |

PE NUMBER: 0602602F PE TITLE: Conventional Munitions

| | Exhi | bit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 |
|------|---|---|------------------------------------|----------------------------------|--------------------|-----------------|-----------------|---------------|------------------|--------------------------|
| | ET ACTIVITY oplied Research | | | | E NUMBER AND | | initions | | rebruary | 2004 |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ III Minifolis) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| | Total Program Element (PE) Cost | 62.802 | 46.061 | 52.251 | 50.260 | 54.704 | 52.684 | 53.998 | 0.000 | 0.00 |
| 2068 | | 16.905 | 16.589 | 16.359 | 16.454 | 16.960 | 17.366 | 17.717 | 0.000 | 0.00 |
| 2502 | Ordnance Technology | 45.897 | 29.472 | 35.892 | 33.806 | 37.744 | 35.318 | 36.281 | 0.000 | 0.00 |
| (U) | A. Mission Description and Budget Ite This program investigates, develops, and air-launched munitions. The program in- detection and identification algorithms, a munitions integration, and weapon lethal | l establishes the to cludes two project and simulation as | cts: (1) develop sessments; and | ment of advance (2) developme | ced guidance te | chnologies, inc | luding seekers, | navigation an | d control, targe | t |
| U) | <u>B. Program Change Summary (\$ in M</u> | (illions) | | | | | FY 2003 | EV | 2004 | <u>FY 2005</u> |
| U) | Previous President's Budget | | | | | | <u>58.802</u> | | 5.455 | <u>F1 2005</u> 50.351 |
| | Current PBR/President's Budget | | | | | | 62.802 | | .061 | 52.251 |
| | Total Adjustments | | | | | | 4.000 | | .394 | 52.251 |
| | Congressional Program Reductions | | | | | | | Ū | | |
| - / | Congressional Rescissions | | | | | | | -0 | .394 | |
| | Congressional Increases | | | | | | | | | |
| | Reprogrammings | | | | | | 4.000 | | | |
| | SBIR/STTR Transfer | | | | | | | | | |
| U) | Significant Program Changes: | | | | | | | | | |
| | Not Applicable. | | | | | | | | | |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | | | R-1 Sh | opping ist - Item | n No. 11-1 of 11-9 | 9 | | | Exhibit R-2 (I | PE 0602602F |
| | | | | 221 | | / | | | | - 00020021 |

| | Ext | hibit R-2a, F | RDT&E Pro | ject Justifi | cation | | | DATE | February | 2004 |
|-------|---|--|---|---|---|------------------------------------|-----------------------------------|------------------------|-------------------------|-------------------------|
| | BET ACTIVITY pplied Research | unitions | PROJECT NUM 2068 Advance | BER AND TITLE | e Technology | | | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| 20.69 | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | 0.000 |
| 2068 | Advanced Guidance Technology Quantity of RDT&E Articles | 16.905 0 | <u>16.589</u> 0 | 16.359 0 | <u>16.454</u> 0 | 16.960 0 | 17.366 0 | | 0.000 | 0.000 |
| (U) | <u>A. Mission Description and Budget Iter</u> This project investigates, develops, and ev project includes development of advanced simulations. Project payoffs include: adv survivability; improved reliability and aff | valuates conven 1 guidance inclu erse-weather an | iding terminal s d autonomous | seekers, navigat precision guida | tion and contro ince capability; | l, signal and pr increased num | ocessing algor ber of kills pe | rithms, and guid | lance and contr | ol |
| (U) | B. Accomplishments/Planned Program (MAJOR THRUST: Investigate and develo autonomous seekers for air-delivered muni pre-processing, target recognition, spatial t technologies. These technologies will enal weapon's kill probability, reduce pilot worl | op advanced gui itions, such as d arget characteri ble the develop | etectors and de stics, optics, ar nent of next ge | etector arrays, re ad low-cost bea eneration seeker | eceiver electror m scanning and | nics, signal 1 shaping | FY | <u>7 2003</u> 6.779 | <u>FY 2004</u> 6.471 | <u>FY 2005</u> 6.100 |
| | In FY 2003: Tested in-house, high-through ranging and detection seeker components t selection, and weather penetration effective advanced guidance applications. | o quantify operation of the quantify operati | ational range, t d a low-cost, sy | arget detection onthetic apertur | and identification of the second s | ion, aim-point to assess future | | | | |
| | In FY 2004: Develop a low-cost, synthetic Initiate demonstration of a laser ranging an technology. | | | | | | | | | |
| | In FY 2005: Continue testing laser ranging technology. Begin ground testing a low-co applications. Initiate design of an optical s obscured or hidden targets. | ost, synthetic ap | erture radar see | eker to assess fu | uture advanced | guidance | | | | |
| (U) | C C | | | | | | | | | |
| | MAJOR THRUST: Investigate and develor to include nonlinear controllers, biomimeti and micro-electromechanical gyros. These stand off ranges, and enhance strike aircraft | c guidance, clut e technologies w | tter rejection m | odules, detection re efficient fligh | on and segment | tation modules, | | 4.758 | 4.500 | 4.204 |
| | In FY 2003: Completed laboratory field-te guidance system capable of operating in hi | - | | | | | | | | |
| | ect 2068 | giny dynamic n | • | nopping List - Iten | | • | | | Exhibit R-2a (| PE 0602602F) |
| | | | | 222 | | | | | , | , |

| | Exhibit R-2a, RDT&E Project Just | ification | l | DATE February 2 | 2004 |
|------------|--|---|-------|-------------------------------------|-------------|
| | GET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602602F Conventional Munitions | | NUMBER AND TITLE vanced Guidance | Technology |
| (U) | System jamming devices. Designed new technologies for tactical munitions flight co development of novel ways to enhance weapon system effectiveness through higher I navigation, control, and estimation algorithms. Investigated neuro-physiology of inse Investigated clutter and multi-discriminate rejection to defeat camouflage, concealme In FY 2004: Continue evaluating new design technologies for tactical munitions fligh developing novel ways to enhance weapon system effectiveness through higher levels navigation, control, and estimation algorithms. Continue investigating the neuro-phy applications to guidance. Investigate concepts for penetrator guidance below the group | evels of integration of guidance, ects for applications to guidance. ent, and deception. ht control systems. Continue s of integration of guidance, siology of insects for | | | |
| (U) | In FY 2005: Continue developing new design technologies for tactical munitions flig modeling and simulation testbed for developing novel ways to enhance weapon syste levels of integration of guidance, navigation, control, and estimation algorithms. Cor neuro-physiology of insects for applications to guidance. Continue investigating com- below the ground. | m effectiveness through higher ntinue investigating the | | | |
| (U) (U) | MAJOR THRUST: Investigate and develop advanced optical and digital processors classification, and identification algorithms for improved seeker performance to allow autonomy. These seekers will deny an enemy the ability to hide or camouflage a targ pilot's workload. | v greater air-delivered weapon | 2.005 | 1.892 | 2.250 |
| (U) | In FY 2003: Evaluated highly innovative concepts and approaches in guidance and c principles and concepts, including foveal vision and neuromorphic imaging systems, moving target scenarios. Investigated algorithms to perform flight trajectory shaping | for use in advanced seekers for | | | |
| (U) (U) | In FY 2004: Enhance development of highly innovative concepts and approaches in advanced seekers for moving target scenarios. Using digital simulation and hardware biomimetic principles developed by the Air Force Office for Scientific Research for we These sensors will emulate biological or human characteristics for use in advanced see target scenarios. Complete investigation of algorithms to perform flight trajectory sh design effects. Initiate investigating polarization measurement to differentiate the proform natural backgrounds. In FY 2005: Continue developing highly innovative concepts and approaches in guid transitioning biomimetic principles developed by the Air Force Office for Scientific F sensors. These sensors will emulate biological or human characteristics for use in admoving target scenarios. Continue investigating polarization measurement to differentiate the principles developed by the Air Force Office for Scientific F sensors. These sensors will emulate biological or human characteristics for use in admoving target scenarios. Continue investigating polarization measurement to differentiate to differentiate biological or human characteristics for use in admoving target scenarios. Continue investigating polarization measurement to differentiate to differentiate the proference of the sensors. These sensors will emulate biological or human characteristics for use in admoving target scenarios. Continue investigating polarization measurement to differentiate the proference of the sensor of th | e in the loop testing, transition variable resolution sensors. weker components for moving aping that reduces human error operties of manmade materials lance and control. Continue Research for variable resolution vanced seeker components for entiate the properties of | | | |
| (U) | optic-flow algorithms. | | | | |
| Pr | bject 2068 R-1 Shopping List - | Item No. 11-3 of 11-9 | | Exhibit R-2a (P | E 0602602F) |

| BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND TITLE 024 Applied Research 06020287 Conventional Munitions 2088 Advanced Guidance Technology (U) MATOR THRUST: Investigate and develop detailed six-degree-of-freedom and hardware-in-the-loop simulations 3.363 3.726 3.805 include trajectory optimization algorithm and polarization scenism and models to unalyze guided munitions. 3.363 3.726 3.805 (U) MATOR THRUST: Investigate and development costs, and provide more effective munitions. 3.363 3.726 3.805 (II) IF Y 2003: Analyzed efforts and multi-sensor modeling to improve target signature prediction models, crypdite development, and reduce the acquisition cycle expense for state-of-the-at seckers. Investigated the long-term technology and strategy for developing an advanced laser ranging and detection scene projector expension conducting to improve target signature prediction models, expedite development, and reduce the acquisition cycle expense for state-of-the-art seckers. Complete investigating the long-term technology and strategy of developing two-dimensional laser arrays for laser ranging and detection scene projector capability. Complete developing two-dimensional laser arrays for laser ranging and detection scene projector. Complete developing two-dimensional laser arrays for laser ranging and detection scene projector capability. Complete developing two-dimension modeling to improve target signature prediction models, eveloping and strategy of developing modulux, system-level, analysis tool to provide comprehensive com | | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|---|-----|--|--|---|---|--|--|----------|--------|----------------|--------------|
| including synthetic aperture radar, automatic target recognition, and biomimetic processing. Technologies also include trajectory optimization algorithm and polarization sensing and models to analyze guided munitions. (U) In FY 2003. Analyzed offorts and multi-sensor modeling to improve target signature prediction models, expedited development, and reduce the acquisition cycle expense for state-of-the-art seekers. Investigated the long-term technology and strategy for developing an advanced laser radar scene projector. Provided detailed performance estimates of guidance-related component technology, using six-degree-of-freedon simulations, for guided weapon systems. Enhanced modular, system-level, analysis tools development to provide comprehensive comparisons among inventory, plannel, and conceptual munitions to identify high pay-off technologies and weapon attributes. (U) In FY 2004: Continue analysis efforts and multi-sensor modeling to improve target signature prediction models, capedite development, and reduce the acquisition cycle expense for state-of-the-art seekers. Complete investigating the long-term technology and strategy for developing an advance laser ranging and detection scene projector. Complete development, and reduce the acquisition cycle expense for state-of-the-art seekers. Complete investigating the long-term technology and strategy for developing and advance laser ranging and detection scene projector. Complete development weapon systems. Continue developing modular, system-level, analysis tools to provide compensive comparisons annog inventory. Planned, and conceptual munitions to identify high pay-off technologies and multi-sensor modeling to improve target signature prediction models, expedite development, and reduce the acquisition cycle expense for state-of-the-art seekers. Continue development of simulation model, reusable end system signature prediction m | | | | | | | | unitions | | | e Technology |
| development, and reduce the acquisition cycle expense for state-of-the-art seckers. Investigated the long-term technology and strategy for developing an advanced laser ranging communitions, for guided weapon systems. Enhanced modular, system-level, analysis tools development to provide comprehensive comparisons among inventory, planned, and conceptual munitions to identify high pay-off technologies and weapon attributes. (U) In FY 2004: Continue analysis efforts and multi-sensor modeling to improve target signature prediction models, expedite development, and reduce the acquisition cycle expense for state-of-the-art seekers. Complete investigating the long-term technology and strategy for developing an advanced laser ranging and detection scene projector. capability. Complete developing two-dimensional laser arrays for laser ranging and detection scene projectors. Complete providing detailed performance estimates of guidance-related component technology, using six-degree-of-freedom simulations, for guided weapon systems. Continue developing modular, system-level, analysis tools to provide comprehensive comparisons among inventory, planned, and conceptual munitions to identify high pay-off technologies and weapon attributes. (U) In FY 2005: Continue analysis efforts and multi-sensor modeling to improve target signature prediction models, expedite development, and reduce the acquisition cycle expense for state-of-the-art seekers. Continue development of simulations, forts and multi-sensor modeling to improve target signature prediction models, expedite development, and reduce the acquisition cycle expense for state-of-the-art seekers. | (U) | including synthetic aperture radar, a include trajectory optimization algo components that will enable require | automatic target r prithm and polariz ement studies, des | ecognition, and ation sensing a sign iteration ar | l biomimetic pro and models to an ad evaluation, an | cessing. Techno alyze guided mu d experiment ris | ologies also mitions and their sk reduction. | | 3.363 | 3.726 | 3.805 |
| expedite development, and reduce the acquisition cycle expense for stale-of-the-art seekers. Complete investigating the long-term technology and strategy for developing an advanced laser ranging and detection scene projector capability. Complete developing two-dimensional laser arrays for laser ranging and detection scene projectors. Complete providing detailed performance estimates of guidance-related component technology, using six-degree-of-freedom simulations, for guided weapon systems. Continue developing modular, system-level, analysis tools to provide comprehensive comparisons among inventory, planned, and conceptual munitions to identify high pay-off technologies and weapon attributes. (U) In FY 2005: Continue analysis efforts and multi-sensor modeling to improve target signature prediction models, expedite development, and reduce the acquisition cycle expense for state-of-the-art seekers. Continue development of simulator model, reusable end system simulation tools. Develop a prototype waveform generator, meeting DoD simulator requirements, using a commercial synthesizer chip. (U) Total Cost 16.905 16.589 /ul> | | development, and reduce the acquist technology and strategy for develop estimates of guidance-related comp systems. Enhanced modular, system inventory, planned, and conceptual | ition cycle expen- ping an advanced onent technology n-level, analysis munitions to iden | ise for state-of- laser radar scen y, using six-deg tools developm ntify high pay-o | the-art seekers. ne projector. Pro ree-of-freedom s lent to provide co off technologies | Investigated the ovided detailed p imulations, for omprehensive co and weapon attr | long-term performance guided weapon omparisons among ibutes. | g 5 | | | |
| (U) In FY 2005: Continue analysis efforts and multi-sensor modeling to improve target signature prediction models, expedite development, and reduce the acquisition cycle expense for state-of-the-art seekers. Continue development of simulation model, reusable end system simulation tools. Develop a prototype waveform generator, meeting DoD simulator requirements, using a commercial synthesizer chip. (U) Total Cost 16.905 16.589 16.590 16.590 | (U) | expedite development, and reduce t the long-term technology and strate capability. Complete developing tw Complete providing detailed perfor six-degree-of-freedom simulations, tools to provide comprehensive com | he acquisition cy gy for developing vo-dimensional la mance estimates for guided weap nparisons among | cle expense for g an advanced l aser arrays for l of guidance-rel on systems. Co | state-of-the-art a laser ranging and aser ranging and ated component ontinue developin | seekers. Compl detection scene detection scene technology, using modular, syst | ete investigating e projector e projectors. ng em-level, analysi | s | | | |
| (U)Total Cost16.90516.58916.359(U)C. Other Program Funding Summary (\$ in Millions)Total CostTotal CostTotal Cost(U)FY 2003FY 2004FY 2005FY 2006FY 2007FY 2008FY 2009Cost to CompleteTotal Cost(U)Related Activities:FE 0603601F, Conventional Weapons Technology. This project has beenFe 0603601F, Conventional Weapons Technology. This project has beenCompleteTotal Cost(U)Coordinated through the Reliance process to harmonizeFe 0603601F, Conventional CompleteFe 0603601F, Conventional <td>(U)</td> <td>In FY 2005: Continue analysis effore expedite development, and reduce t simulation model, reusable end systemeters and set of the /td> <td>orts and multi-sen he acquisition cy tem simulation to</td> <td>cle expense for ols. Develop a</td> <td>state-of-the-art</td> <td>seekers. Contin</td> <td>ue development o</td> <td>f</td> <td></td> <td></td> <td></td> | (U) | In FY 2005: Continue analysis effore expedite development, and reduce t simulation model, reusable end systemeters and set of the | orts and multi-sen he acquisition cy tem simulation to | cle expense for ols. Develop a | state-of-the-art | seekers. Contin | ue development o | f | | | |
| FY 2003 FY 2004 FY 2005 FY 2006 FY 2007 FY 2008 FY 2009 Cost to Complete Total Cost (U) Related Activities: PE 0603601F, Conventional PE 0603601F, Conventional Total Cost Total Cost FY 2009 Cost to FY 2009 Cost to Total Cost (U) PE 0603601F, Conventional Veapons Technology. This project has been FY 2009 Cost to FY 2009 FY 2009 Cost to FY 2009 Cost to FY 2009 FY 2009 </td <td>(U)</td> <td></td> <td>, and the second se</td> <td>I</td> <td></td> <td></td> <td></td> <td></td> <td>16.905</td> <td>16.589</td> <td>16.359</td> | (U) | | , and the second se | I | | | | | 16.905 | 16.589 | 16.359 |
| PE 0603601F, Conventional Weapons Technology. This project has been coordinated through the Reliance process to harmonize | (U) | C. Other Program Funding Sum | <u>FY 2003</u> | FY 2004 | | | | | | | Total Cost |
| | (U) | PE 0603601F, Conventional Weapons Technology. This project has been coordinated through the Reliance process to harmonize | | | | | | | | | |
| Project 2068 R-1 Shopping List - Item No. 11-4 of 11-9 Exhibit R-2a (PE 0602602F) 224 224 | Pro | ject 2068 | | | | | 11-9 | | | Exhibit R-2a (| PE 0602602F) |

| 02 A | BET ACTIVITY pplied Research | | | February 2004 |
|------|--|--|-------------------------|---|
| | pplied Research | PE NUMBER AND TITLE 0602602F Conventional Munitions | PROJECT NU 2068 Adva | MBER AND TITLE nced Guidance Technology |
| | <u>C. Other Program Funding Summary (\$ in Millions)</u> duplication. | | | |
| (U) | D. Acquisition Strategy Not Applicable. | | | |
| | | | | |
| | | | | |
| | ect 2068 | R-1 Shopping List - Item No. 11-5 of 11-9 | | Exhibit R-2a (PE 0602602F) |

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|------|--|--|--|--|---|--|----------------------------------|-----------------------------------|----------------------------------|-------------------------|
| | GET ACTIVITY pplied Research | | | | PE NUMBER AND | | unitions | PROJECT NUM 2502 Ordnan | BER AND TITLE | ду |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| - | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | 0.000 |
| 2502 | 2 Ordnance Technology Quantity of RDT&E Articles | 45.897 0 | 29.472 | 35.892 | 33.806 | 37.744 | 35.318 | | 0.000 | 0.000 |
| (U) | A. Mission Description and Budget Item This project investigates, develops, and evaluated conventional weapon dispensers also assesses the lethality and effectiveness improved storage capability and transport airframe/subsystem components and struct | valuates conven s, submunitions ss of current and ation safety of f | , safe and arm o l planned conve fully assembled | devices, fuzes, entional weapo weapons; imp | explosives, wa ons technology proved warhead | rheads, and we programs and a | apon airframe issesses target | and carriage te vulnerability. | chnology. The The payoffs inc | project lude: |
| (U) | B. Accomplishments/Planned Program (MAJOR THRUST: Investigate and develor for predicting weapons' effects and assessin munitions development costs and provide v | op high fidelity ang target vulner weapons that ca | ability. These an generate max | analysis tools v imum lethality | will reduce air-o against a giver | delivered n target class. | <u>F</u> Y | <u>7 2003</u> 6.507 | <u>FY 2004</u> 6.321 | <u>FY 2005</u> 7.125 |
| | In FY 2003: Developed new hydro-code to cutting, detonation waves, shear banding, a fragmentation effects against various target phenomenology tests to provide data for th targets. Applied campaign analysis tools to payoff technologies. | nd phase transi t facilities, inclu e development o compare inver | tions. Upgrade iding weapons of lethality and ntory, budgeted | d and refined l of mass destru vulnerability o , and conceptu | basic models de ction (WMD). codes for groun al munitions to | escribing Performed d-fixed WMD identify high | | | | |
| | In FY 2004: Continue upgrading and refin facilities, including WMD. Continue apply conceptual munitions to identify high payo for blast effects, combined effects environr the penetration performance of unitary pen- | ving campaign a ff technologies. nent, and target etrating materia | nalysis tools to Develop impr structural resp ls into complex | o compare inve oved engineer onse. Improve a target structu | entory, budgeted ing level predic e methodologies res. | l, and tive methods s for predicting | | | | |
| | In FY 2005: Continue upgrading and refin facilities, including hardened facilities and budgeted, and conceptual munitions to ider level predictive methods with a simplified instability caused by direct weapon hits. D in deep underground facilities. | WMD. Contin ntify high payof finite element n | ue using campa f technologies. hodel that estim | ign analysis to Continue dev nates the damag | pols to compare reloping improv ge from collaps | inventory, red engineering e and | | | | |
| (U) | | cc: : | | | 1 1 | . 1 | | 5 0 00 | 4.050 | 5 110 |
| | MAJOR THRUST: Investigate and develo | p more efficien | | - | • | | | 5.206 | 4.050 | 5.119 |
| Pro | ect 2502 | | R-1 Sh | | m No. 11-6 of 11- | 9 | | | Exhibit R-2a (| PE 0602602F) |
| | | | | 226 | J | | | | | |

| | Exhibit R-2a, RDT&E Project Jus | stification | | February 2 | 2004 |
|------------|--|--|-------|--------------------------------------|-------------|
| | GET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602602F Conventional Munitions | | NUMBER AND TITLE Inance Technolog | у |
| | additives, tungsten-laden explosives, cast and cure high energy composite explosive provide both higher blast performance and lower ignition sensitivity for air-delivere will enable safer, less expensive explosive fills for inventory and future weapons. | | | | |
| (U) | In FY 2003: Completed creation of new, advanced, intermolecular energetic maternano-scale fuel and oxidizer particles. Completed efforts to develop a new class of shaped charges, and explosively formed projectiles. Enhanced a highly energetic mover density of conventional explosives, but exhibiting insensitive munition attribe explosive capable of surviving Mach 4 impacts that will still functions as desired we Completed research of dense reactive metal explosives and investigated cost-effective explosives. | materials for use in fragments, aterial development with twice the utes. Evaluated materials for hen initiated by the fuze. | | | |
| | In FY 2004: Continue developing a highly energetic material that has twice the powexplosives, while still exhibiting insensitive munition attributes. Complete develop surviving Mach 4 impacts that still functions as desired when initiated by the fuze. evaluation methodologies to test the munition application performance of high energother laboratories. Initiate increasing the energy output while maintaining the product composite explosives by using advanced energetic materials, plasticizers techniques | ment of an explosive capable of Develop characterization and gy density materials developed in acible capability of cast and cure s, and formulation techniques. | | | |
| | In FY 2005: Continue developing a highly energetic material with twice the power explosives, while still exhibiting insensitive munition attributes. Continue increasin maintaining the producibility of cast/cure Plastic Bonded Explosives (PBX) compose energetic materials, plasticizers, and formulation techniques. Complete an effort to PBX to enhance near-field lethality when low collateral damage is required. | g the energy output while site explosives, by using advanced | | | |
| (U) (U) | MAJOR THRUST: Investigate and develop advanced fuze technologies for air-del commercially available micro-mechanical systems, shock-hardened fuzes, low ener modular firing systems for advanced single-point initiation, switches, capacitors, per components. These advanced fuze technologies will enhance lethality through prece above, or below the surface to increase weapon safety and tactical performance whit procurement costs and system supportability requirements. | gy detonators, light activated and wer sources, and safe-arming ise selection of burst-height at, | 7.116 | 6.340 | 6.705 |
| (U) | In FY 2003: Designed a high resolution, electromagnetic countermeasure-hardened calculates warhead burst direction and detonation time. Determined the benefits of target fuze using sensors such as micro-electromechanical system gyroscopes. Invectormunicate battle damage assessment information through hardened mediums. | developing a high-speed, hard | | | |
| (U) | In FY 2004: Continue developing a high resolution, electromagnetic countermeasu that calculates warhead burst direction and detonation time. Complete investigating battle damage assessment information through hardened mediums. Develop miniat | technologies that communicate urized fuze to effectively control | | | |
| Pr | ject 2502 R-1 Shopping List | - Item No. 11-7 of 11-9 | | Exhibit R-2a (P | E 0602602F) |

| Exhibit R-2a, RDT&E Project Justification | | TE February | 2004 |
|---|--------|-----------------|--------------|
| JDGET ACTIVITY PE NUMBER AND TITLE 2 Applied Research 0602602F Conventional Munitions | | UMBER AND TITLE | |
| the release of anti-agent and submunition for defeating weapons of mass destruction. J) In FY 2005: Continue developing a high resolution, electromagnetic countermeasure-hardened, active imaging fuze that calculates warhead burst direction and detonation time. Continue developing a miniaturized fuze to effectively control the release of anti-agent for defeating weapons of mass destruction. Begin developing a miniaturized fuze to provide safe and arm, burst point sensor and low power initiator in a 4 cubic inch package. Develop a wireless communication system to fuze a hard target munition. | | | |
| MAJOR THRUST/CONGRESSIONAL ADD: Investigate and develop control and carriage technologies for ordnance packages for advanced air-delivered munitions in order to enhance weapon lethality. Examples of these technologies include high-energy explosives, mass-focus fragmentation, and multi-sensor fuzing. These technologies will increase weapon systems effectiveness by contributing to increased weapon load-out on strike aircraft and enhanced sortie effectiveness. Note: This effort includes \$1.1 million in FY2003 Congressional Add funding for defense against Weapons of Mass Destruction. | 13.146 | 5.567 | 8.745 |
| J) In FY 2003: Investigated and compared subsystem technologies necessary to develop an optimum kill missile against low-observable, air targets. Investigated technologies, such as microbots and nano-encapsulation, to disrupt, deny, destroy, or damage facilities containing chemical and biological weapons. Investigated technologies that can defeat hard and deeply buried targets by simultaneously placing multiple, precise, time-of-arrival guided munitions on target. | | | |
| J) In FY 2004: Continue investigating subsystem technologies necessary to develop an optimum kill missile against low-observable, air targets. Perform concept trade studies to determine the technologies necessary to deny adversary operations over long, stand off ranges. | | | |
| In FY 2005: Finish investigating specific missile subsystem technologies to counter low-observable, air targets. Begin an effort to design and ground test precise time-of-arrival munitions. Begin to identify the critical technologies needed for an advanced next generation, low cost mini-cruise missile. Begin developing technologies to deny enemy operations through loitering low-cost multi-shot munitions. | | | |
| J) | | | |
| J) MAJOR THRUST: Investigate and develop advanced warhead kill mechanisms, such as adaptable warhead, directional control and fragmenting ordnance, and application of reactive metals. The investigation includes characterization of the dynamic response of metals and geologic materials, adjustable yield ordnance packages, and distributed multi-point fire set to enhance air-delivered munition lethality. This enhanced lethality supports the development of smaller munitions with effectiveness similar to current inventory weapons and with a corresponding increase in aircraft load-out and sortie effectiveness. | 13.922 | 7.194 | 8.198 |
| J) In FY 2003: Evaluated initiation-based, adaptable, and multi-mode warheads using enhanced lethality materials and miniaturization technologies for the advanced warhead kill mechanism. Evaluated ordnance technology to reduce fratricide in urban warfare scenarios. Completed assessment of multi-mode warheads using heavy metal liners to enhance lethality. Completed in-house experiments to characterize the interaction of munitions with chemical and | | | |
| Project 2502 R-1 Shopping List - Item No. 11-8 of 11-9 | | Exhibit R-2a (| PE 0602602F) |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|---|---|--|---|---|--|--|-----------------------------------|-----------------------------------|-----------------------------------|-------------------|
| BUDGET ACTIVI 02 Applied R | | | | | PE NUMBER A 0602602F C | ND TITLE | lunitions | PROJECT NUM 2502 Ordnar | | |
| by focusin while pend be carried | weapon and storage conta g on improving warhead c etrating hardened material to required depth of target | case survivability and decreasing t. | y, control of dep case thickness t | oth of burial, traj o allow a greater | ectory control n amount of ener | nethodologies getic material to | 15 | | | |
| materials a ordnance y an effort to control of thickness evaluating provide ac techniques blast explo | 4: Complete evaluating ir and miniaturization technologickage designed for low of package designed for low of o improve the attributes of depth of burial, trajectory to allow a greater amount of tungsten to be used for hi- laptable warhead technologics to characterize the dynam- psive mechanisms. 5: Continue evaluating an | ologies for the ac collateral damag penetrating mut control methodo of energetic mat gh-speed, penetrating gies to better att nic response of r | lvanced warhea e with high nea nitions by focus ologies while pe erial to be carrie rating-warhead ack mobile grou netals used for | d kill mechanism r-field and mini- ing on improvin- enetrating harder ed to the require case material. I und targets. Dev warhead cases. | n. Continue eva mum far-field le g warhead case led material and d depth of target Develop the desig elop experiment Investigate effect | luating an thality. Continue survivability, decreasing case t. Begin gn constraints to tal data analysis ctiveness of large | | | | |
| minimum in-house e case thick | far-field lethality. Complete ffort to improve penetration ness. Continue evaluating ble warheads to attack mo | ete evaluation of ng warhead case g tungsten for hi | E low collateral survivability, d gh-speed penetr | damage, multi-n epth of burial, a | node warheads. nd trajectory con | Continue ntrol, with lower | S | | | |
| (U) Total Cost | : | | | | | | | 45.897 | 29.472 | 35.892 |
| (U) <u>C. Other</u> | Program Funding Sumn | | | | | | | | | |
| Weapons This projector Coordinate Reliance projector efforts and duplication | 01F, Conventional Technology. ect has been ed through the process to harmonize d eliminate n. sition Strategy | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| Project 2502 | | | F | R-1 Shopping List | Item No. 11-9 of | 11-9 | | | Exhibit R-2a | (PE 0602602F) |

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PE NUMBER: 0602605F PE TITLE: DIRECTED ENERGY TECHNOLOGY

| | xhibit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | Fobruary | 2004 |
|---|--|--|--|---|---|--|--|---|---------------------------|
| BUDGET ACTIVITY D2 Applied Research | | | PI | E NUMBER AND | | | LOGY | February | 2004 |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| Cost (\$ III Millions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| Total Program Element (PE) Cost | t 35.661 | 42.077 | 36.532 | 38.540 | 44.413 | 43.223 | 43.065 | 0.000 | 0.0 |
| 4866 Lasers & Imaging Technology | 20.966 | 27.478 | 20.991 | 23.231 | 26.715 | 26.146 | 25.939 | 0.000 | 0.0 |
| 4867 Advanced Weapons & Survivabili Technology Note: In FY 2003, space unique tasks in Pro- | 14.695 | 14.599 | 15.541 | 15.309 | 17.698 | 17.077 | 17.126 | 0.000 | 0.00 |
| (U) <u>A. Mission Description and Budget</u> This program covers research in direct high power lasers (solid state and che narrowband and wideband high powe FY 2004 Congresses added \$2.5 milli \$2.0 million for Adaptive Optics Lase This program is in Budget Activity 2, technologies. | cted energy technolo emical) and associate er microwave devices lion for the 975 milling ercom, and \$0.5 mill | ed optical comp s and antennas. meter Stabilize ion for the Nat | onents and tech Both areas als d Fiber Laser F ional High Ene | nniques. In adv so provide vuln Pump Developn rgy Laser Cons | vanced weapon erability/lethali nent, \$2.1 milli sortium. | s, this program ity assessments on for the Stabi | examines tech of representati ilized Fiber Las | nologies such a ive systems. N ser Pump Devel | s lote: In lopment, |
| | · Milliona) | | | | | | | | |
| U) <u>B. Program Change Summary (\$ in</u> | <u>a wiinons)</u> | | | | | FY 2003 | FY2 | 2004 | FY 2005 |
| | <u>n Minions)</u> | | | | | <u>FY 2003</u> 37.547 | <u>FY 2</u> 35 | <u>2004</u> .359 | <u>FY 2005</u> 36.239 |
| U) Previous President's Budget | <u>n Minions)</u> | | | | | | 35 | | 36.239 |
| U) Previous President's BudgetU) Current PBR/President's Budget | <u>n minions)</u> | | | | | 37.547 | 35 42 | .359 | |
| U) Previous President's BudgetU) Current PBR/President's BudgetU) Total Adjustments | <u>n Minions)</u> | | | | | 37.547 35.661 | 35 42 6 | .359 .077 | 36.239 |
| U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments | <u>n minons)</u> | | | | | 37.547 35.661 | 35 42 6 -0 | .359 .077 .718 | 36.239 |
| U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments U) Congressional Program Reductions Congressional Rescissions Congressional Increases | <u>n minons</u>) | | | | | 37.547 35.661 -1.886 | 35 42 6 -0 -0 | .359 .077 .718 .022 | 36.239 |
| U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments U) Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings | <u>n Minions)</u> | | | | | 37.547 35.661 -1.886 0.383 | 35 42 6 -0 -0 | .359 .077 .718 .022 .360 | 36.239 |
| U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments U) Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings SBIR/STTR Transfer | <u>n Minions)</u> | | | | | 37.547 35.661 -1.886 | 35 42 6 -0 -0 | .359 .077 .718 .022 .360 | 36.239 |
| U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments U) Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings | <u>a minons</u>) | | | | | 37.547 35.661 -1.886 0.383 | 35 42 6 -0 -0 | .359 .077 .718 .022 .360 | 36.239 |

| | ExI | hibit R-2a, I | RDT&E Pro | oject Justif | fication | | | DATE | February | 2004 |
|------------|---|--|-----------------|------------------|--|-------------------------------|------------------------------------|--------------------------------------|--------------------------------------|----------------|
| | ET ACTIVITY pplied Research | | | | PE NUMBER AND 0602605F DIR TECHNOLOG | ECTED ENER | RGY | PROJECT NUMI 4866 Lasers | BER AND TITLE & Imaging Te | chnology |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 4866 | | 20.966 | 27.478 | 20.991 | 23.231 | 26.715 | 26.146 | | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | | 0 | 0 | Ŷ | | |
| | In FY 2003, space unique tasks in Project e activities. <u>A. Mission Description and Budget Iter</u> This project examines the technical feasity short-range weapons, weapon support suc Tashnologies applicable for a wide range | n Justification bility of modera th as aimpoint s | te to high powe | er lasers and as | ssociated optical | components registed developed | equired for Air in this project | · Force missions are not uniquely | s including long y space-oriented | - and 1. |
| | Technologies applicable for a wide range devices, optical components, advanced be processes and techniques are developed. assessment are developed. | am control and | atmospheric c | ompensation to | echnologies, lase | er target vulner | ability assessr | nent techniques | , and advanced | optical |
| | B. Accomplishments/Planned Program (| <u>(\$ in Millions)</u> | | | | | <u>FY</u> | <u>7 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| (U) | MAJOR THRUST: Civilian salaries. In FY 2003: This project previously includ Multi-disciplinary Space Technology. The left behind. | | | | | | | 2.484 | 0.000 | 0.000 |
| (U) (U) | In FY 2004: Not Applicable. In FY 2005: Not Applicable. | | | | | | | | | |
| 1 | MAJOR THRUST: Develop advanced las chemical/biological aerosols for signature : target characterization; and theater intellige In FY 2003: Developed design and hardw | intelligence on ence, surveillan | weapons of ma | aissance. | ; bomb damage a | assessment; | | 1.661 | 0.000 | 0.000 |
| : | for an airborne system. Effort was termina | ted in order to t | fund higher pri | ority efforts. | | | | | | |
| | In FY 2004: Not Applicable. | | | | | | | | | |
| | In FY 2005: Not Applicable. | | | | | | | | | |
| , | MAJOR THRUST: Develop high power c weapons, illuminators, and wavelength spe In FY 2003: Improved high pressure eject | ecific application | ns. | | | | | 4.222 | 4.594 | 5.121 |
| Ì, í | | or nozzie perior | | e | 1 | 0 0 | | | | |
| Proje | ect 4866 | | K-1 50 | 232 23 | m No. 12-3 of 12-1 2 | I | | | Exhibit R-2a (F | - UOUZOUOF) |

| Exhibit R-2 | a, RDT&E Project Justification | | DA | February | 2004 |
|--|--|--|-------|-----------------------------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND 0602605F DIRI TECHNOLOG | ECTED ENERGY | | MBER AND TITLE 's & Imaging Te | chnology |
| technology insertion into applications such as airborn and zero-gravity singlet delta oxygen generators for a kilowatt supersonic all gas-phase iodine laser. Impro carbon monoxide laser in various spectral bands of in applications. (U) In FY 2004: Perform sub-scaled evaluation of optimiz generation for airborne applications. Evaluate the feature | irborne applications. Investigated a combustor-dr ved the efficiency of the radio frequency-pumped terest for infrared countermeasure and remote sen ized high pressure ejector nozzles and integrated in | iven one overtone sing odine atom | | | |
| zero-gravity singlet delta oxygen generator concepts regeneration of laser consumables to reduce chemical | for airborne applications. Investigate the feasibilit | | | | |
| (U) In FY 2005: Evaluate enhanced scaled-up versions o generation as appropriate for potential long-range tec scalability of high performance zero-gravity singlet d Demonstrate chemical regeneration techniques or sin chemicals required for each mission. | f the high pressure ejector nozzles incorporating ic hnology insertion into airborne laser applications. elta oxygen generator concepts for airborne laser a | Investigate applications. | | | |
| (U) | | | | | |
| (U) MAJOR THRUST: Develop high energy laser technologies being addresse surface-to-air scenarios. Technologies being addresse high power, high-brightness, multi-wavelength comp platform vibration, atmospheric jitter, and aero-optica | ed include lasers for long-range detection of target act lasers; and advanced beam control techniques | ts in clutter; | 4.726 | 4.252 | 4.677 |
| (U) In FY 2003: Investigated laser sources and supportin electro-optic targets. Demonstrated 30-watt, near-dif issues for advanced tactical applications. Conducted enhanced Battlefield Air Operations Kit. | g technology for detecting, identifying, tracking, a fraction-limited, 1.5 micron eye-safe laser. Addre | essed packaging | | | |
| (U) In FY 2004: Collect aero-optical data from tactical a management issues and packaging/integration/test iss Demonstrate improvements in semiconductor laser ef tactical systems and combat identification systems. | ues for tactical laser weapon applications on airbo | orne platforms. | | | |
| (U) In FY 2005: Address and evaluate system-level solut electro-optic targets. Evaluate potential system-level on airborne platforms. | | - | | | |
| (U) | | | | | |
| (U) MAJOR THRUST: Perform vulnerability assessmen data for laser systems to defeat these targets. | | - | 1.387 | 0.522 | 0.560 |
| (U) In FY 2003: Updated lethality assessment methodolo | by by anchoring modeling tools to empirical data | . Performed | | | |
| Project 4866 | R-1 Shopping List - Item No. 12-4 of 12-1 | 1 | | Exhibit R-2a (F | PE 0602605F) |

| | Exhibit R-2a, RDT&E Pro | Dł | DATE February 2004 | | |
|------------|--|---|-----------------------|-------------------------------------|--------------|
| | GET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY | | UMBER AND TITLE ers & Imaging Te | chnology |
| | finite state modeling of laser targets to better understand vulnerabilities a | and identify indicators for battle damage | - | | |
| | assessment. | | | | |
| (U) | In FY 2004: Identify system constraints and performance in degraded si weather. | tuations, including battlefield conditions and | | | |
| (U) | In FY 2005: Identify additional laser system constraints and performance battlefield conditions and weather. | e in real world situations, including | | | |
| (U) | | | | | |
| (U) | MAJOR THRUST: Develop scalable, high power fiber laser, convention diode laser technologies for next-generation electric laser device applicat designators/imagers and tactical airborne lasers. | • • | 6.210 | 7.367 | 6.611 |
| (U) | In FY 2003: Demonstrated coherent beam combining of multiple high-p power amplifier configuration with free space optics. | power fiber amplifiers in a master oscillator, | | | |
| (U) | In FY 2004: Demonstrate all-fiber approach to beam combining at tens | of watts with ytterbium-doped fiber | | | |
| | lasers/amplifiers. | | | | |
| (U) | In FY 2005: Demonstrate one kilowatt packaged breadboard fiber laser technology of future directed energy, megawatt-class electric lasers. Der laser/nonlinear optics at five watt power levels. | | | | |
| (U) | | | | | |
| | MAJOR THRUST: Develop broadly applicable technologies to support systems. | future tactical and strategic relay mirrors | 0.276 | 0.873 | 0.361 |
| (U) | In FY 2003: Developed light weight, low power optics for relay mirrors | | | | |
| | In FY 2004: Select the best lightweight, low power optics candidate tech development of these optics for potential evaluation on a small-scale (wit testbed. | hnologies for airborne relay mirrors and start | | | |
| (U) (U) | In FY 2005: Investigate and integrate technologies onto an airborne rela | y mirror breadboard for further evaluation. | | | |
| · · · | MAJOR THRUST: Develop optical and beam control technologies to en over long distances in the atmosphere. | nhance high energy laser beam propagation | 0.000 | 2.770 | 3.661 |
| (U) | In FY 2003: Not Applicable. Funds were redirected for FY 2003 to sup | port higher Air Force priorities. | | | |
| | In FY 2004: Evaluate the performance of various wavefront sensors to r | | | | |
| . , | effects on laser beams through laboratory demonstrations. Evaluate a co | | | | |
| | Evaluate novel tracking algorithms. Anchor wave optics propagation co | de to actual beam control performance. | | | |
| (U) | In FY 2005: Develop optical components and complete active tracking e | experiments. Demonstrate advanced tracking | | | |
| | methods and adaptive optics compensation techniques that double the St | rehl ratio (peak intensity on target) in | | | |
| Pro | ject 4866 R-1 Sh | nopping List - Item No. 12-5 of 12-11 | | Exhibit R-2a (I | PE 0602605F) |

| | Exhibit R- | -2a, RDT&E | Project Jus | tification | | | DATE | February | 2004 |
|--|--------------------------|--------------------|---------------------|---------------------------------------|-------------------|----------|----------------------------|-------------------------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | | | | PE NUMBER A 0602605F D TECHNOLO | IRECTED ENE | RGY | PROJECT NUM 4866 Lasers | BER AND TITLE & Imaging To | echnology |
| stressing atmospheric turbulend | ce. Anchor wave opt | ics propagation | code to recent ac | ctual beam contr | ol performance. | | | | |
| (U) | | | | | | | | | |
| (U) CONGRESSIONAL ADD: Na | ational High Energy | Laser Consortiu | m. | | | | 0.000 | 0.500 | 0.000 |
| (U) In FY 2003: Not Applicable. | ahanaina fina naann | lon to onosta o io | int concernment | inductrial month | anahin to quatain | | | | |
| (U) In FY 2004: Develop a compute national industrial base in h | | ian to create a jo | ont government | - industrial parti | to sustain | | | | |
| (U) In FY 2005: Not Applicable. | light powered tasers. | | | | | | | | |
| (U) III 1 2005. Not Applicable. | | | | | | | | | |
| (U) CONGRESSIONAL ADD: St | abilized Fiber Laser I | Pump Developm | nent. | | | | 0.000 | 4.600 | 0.000 |
| (U) In FY 2003: Not Applicable. | | r r r | | | | | | | |
| (U) In FY 2004: Develop single mo | ode devices (optical f | ibers) to allow v | wavelength stabi | ized operation a | t ytterbium | | | | |
| absorption peaks by integrating | a grating into the op | tical fiber struct | ture to control its | operating frequ | ency and to mak | e | | | |
| it less susceptible to temperature | re changes. | | | | | | | | |
| (U) In FY 2005: Not Applicable. | | | | | | | | | |
| (U) | | | | | | | | | |
| (U) CONGRESSIONAL ADD: A | daptive Optics Laser | com. | | | | | 0.000 | 2.000 | 0.000 |
| (U) In FY 2003: Not Applicable:(U) In FY 2004: Design, develop, | integrate and test a t | achnique for eir | to air optical ac | mmunication E | Dealeaga avisting | | | | |
| technology for airborne evaluation | - | - | - | | | | | | |
| Oscura Peak, White Sands Mis | - | | | - | | | | | |
| verified by in-house analysis. | 5110 Italigo, Ito (1110) | | erroringee gour | is no giguen p | | | | | |
| (U) In FY 2005: Not Applicable. | | | | | | | | | |
| (U) Total Cost | | | | | | | 20.966 | 27.478 | 20.991 |
| (U) <u>C. Other Program Funding S</u> | Summary (\$ in Milli | ions) | | | | | | | |
| (C) <u>C. Other Program Funding</u> | <u>FY 2003</u> | <u>FY 2004</u> | FY 2005 | <u>FY 2006</u> | <u>FY 2007</u> | FY 2008 | FY 2009 | Cost to | |
| | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | Total Cost |
| (U) Related Activities: | <u></u> | | | | | | | <u>comprese</u> | |
| PE 0601108F High Energy | | | | | | | | | |
| (U) Laser Research Initiatives. | | | | | | | | | |
| PE 0602500F, | | | | | | | | | |
| (U) Multi-Disciplinary Space | | | | | | | | | |
| Technology. | | | | | | | | | |
| (U) PE 0602890F, High Energy | | | | | | | | | |
| Project 4866 | | F | R-1 Shopping List - | Item No. 12-6 of 1 | 2-11 | | | Exhibit R-2a (| PE 0602605F) |

| Exhibit F | Exhibit R-2a, RDT&E Project Justification | | | | | | |
|--|---|--|--|--|--|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY | PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Technology | | | | | |
| (U) <u>C. Other Program Funding Summary (\$ in Mil</u> Laser Research. (U) PE 0603444F, Maui Space Surveillance System. PE 0603500F, (U) Multi-Disciplinary Advanced Development Space Technology. (U) PE 0603605F, Advanced (Weapons Technology. PE 0603924F, High Energy (U) Laser Advanced Technology Program. (U) Defense Boost Phase Segment. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. | TECHNOLOGY | | | | | | |
| Project 4866 | R-1 Shopping List - Item No. 12-7 of 12-11 | Exhibit R-2a (PE 0602605F) | | | | | |

| | Ext | hibit R-2a, I | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 | |
|------------|--|---|--|---|---|--|--|---|--|-----------------------|--|
| | GET ACTIVITY pplied Research | | | 0 | 0602605F DIRECTED ENERGY 486 TECHNOLOGY Sur | | | | ROJECT NUMBER AND TITLE 867 Advanced Weapons & urvivability Technology | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | |
| 4867 | Technology | 14.695 | 14.599 | 15.541 | 15.309 | 17.698 | 17.077 | 17.126 | 0.000 | 0.000 | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| (U) | A. Mission Description and Budget Iter This project explores high power microwa wide range of Air Force missions such as be applied covertly with no collateral stru defense and command and control system HPM weapon technology assessment for a | ave (HPM) and the potential di ctural or humar as. This project | sruption and de damage. Targ also provides f | egradation of an geted capabiliti for vulnerability | n adversary's ele es include local y assessments o | ectronic infrast computer and f representative | ructure and m communication U.S. strategio | ilitary capability on systems, as w c and tactical sy | y. This effect ca well as large and | an often small air | |
| (U) | B. Accomplishments/Planned Program (| (<u>\$ in Millions</u>) | | | | | <u>FY</u> | <u> </u> | <u>FY 2004</u> | <u>FY 2005</u> | |
| | MAJOR THRUST: Investigate and develo multiple Air Force applications such as the | | | | - | ents to support | | 5.992 | 7.070 | 7.450 | |
| (U) (U) | In FY 2003: Developed technology for co- efficiency of wideband HPM sources in or Conducted pulsed atmospheric breakdown support compact single-shot HPM sources. experiment. Developed conformal phased multi-gigawatt technology for HPM breadt nanotechnology components (nanotubes) to Developed target identification concept usi In FY 2004: Develop compact repetitively experiments. Integrate explosive generator Investigate conformal phased array antenna multi-gigawatt technology for HPM breadt laboratory evaluation of nanotechnology de Utilize nanotechnology and other technolo wideband technology target identification of In FY 2005: Investigate compact repetitive HPM sources in order to achieve greater ra breakdown experiments. Conduct explosive | mpact repetitive der to achieve g experiments. C . Conducted a s array antenna f board munitions o develop catho ing wideband te v operated source r development e a for HPM syste board munitions eveloped cathoo gies to reduce th experiment. ely operated sou inge, longer life | ely operated so reater range, lo Conducted expl ub-scale (labor or HPM system and airborne e des and anodes chnology. e technologies. experiments wite ems. Develop a and airborne e les and anodes he HPM source urces. Further time, and smal | urces. Further onger lifetime, a osive generator ratory) repetitive s. Selected a p electronic attack of repetitivel . Conduct puls th compact sing sub-scale (labo electronic attack for repetitively e weight. Cond improve the ele- | improved the ef and smaller pace r development of rely pulsed giga repetitively pulse k proof-of-conce y pulsed HPM of ed atmospheric gle-shot HPM s ratory) repetitive k proof-of-conce pulsed HPM e luct a sub-scale ectrical efficience Conduct pulsed | kaging. experiments to watt class sed eept. Utilized experiments. breakdown ources. vely pulsed eept. Conduct xperiments. (laboratory) cy of wideband d atmospheric | | | | | |
| | ect 4867 | 5 | | | n No. 12-8 of 12-1 | • | | | Exhibit R-2a (I | PE 0602605F) | |
| | | | 11 101 | | | - | | | | | |

| Exhibit R-2a, RDT& | DA | DATE February 2004 | | |
|--|---|-----------------------|--|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY | 4867 Adva | MBER AND TITLE nced Weapons ity Technology | |
| sources. Conduct a sub-scale (laboratory) repetitively pulsed giga array antenna for HPM systems. Select a repetitively pulsed multi munitions and airborne electronic attack proof-of-concept. Utilize continue development of cathodes and anodes for repetitively puls concept using wideband technology. Further develop wideband te demonstrate increased standoff range. (U) | i-gigawatt technology for HPM breadboard e nanotechnology components (nanotubes) to sed HPM experiments. Develop target identification | | | |
| (U) MAJOR THRUST: Develop and use the ability to assess the effect | cts/lethality of HPM directed energy weapon | 2.567 | 2.160 | 2.315 |
| technologies against representative air and ground systems. (U) In FY 2003: Conducted susceptibility tests of representative communications susceptibility tests to determine relative importance of source paral Implemented effects data and results into narrowband and widebate prediction of probability of effect on experimental targets and to getechniques to incorporate HPM technologies into warfighting/warge codes' ability to adequately predict the electromagnetic coupling techniques structures. Supported implementation of predictive implementation of probability of effect on target equipment and to getechniques to incorporate HPM technologies into warfighting/warge codes to predict probability of effect on target equipment and to getechniques to incorporate HPM technologies into warfighting/warge additional/modified computer codes' ability to adequately predict effect on, target equipment within complex structures. (U) In FY 2005: Conduct further susceptibility tests to determine relative implementation and to get effect on target equipment of codes to predict further susceptibility to adequately predict effect on, target equipment within complex structures. | imeters in causing the desired effects on targets. Ind HPM experiments. Refined codes for better uide program direction. Developed better modeling gaming activities. Validated specific computer o, and probability of effect on, experimental targets we models into existing engagement models. Dortance of source parameters in causing the desired and and wideband HPM experiments. Refine HPM uide experiment direction. Develop better modeling gaming activities. Further validate the electromagnetic coupling to, and probability of tive importance of source parameters to cause o predict probability of effect on target equipment | | | |
| and to guide experiment direction. Refine modeling techniques to warfighting/war gaming activities. Proceed with validation of con electromagnetic coupling to, and probability of effect on, target eq | nputer codes' ability to adequately predict the | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop and apply the theory of advanced co related technology. | mputation to enhance the development of HPM and | 0.760 | 0.752 | 0.791 |
| (U) In FY 2003: Investigated numerical dispersions and enhanced pla technologies. Performed virtual prototyping for HPM component | | | | |
| (U) In FY 2004: Investigate plasma models and develop physics algor | rithms for HPM technologies. Develop improved | | | |
| algorithms for higher frequency wideband HPM modeling. Perfor | | | | |
| Project 4867 | R-1 Shopping List - Item No. 12-9 of 12-11 | | Exhibit R-2a (F | PE 0602605F) |

| | Exhibit R-2a, RDT&E Project | DAT | [™] February | 2004 | |
|------------|--|--|-----------------------|---|--------------|
| | GET ACTIVITY Applied Research | PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY | 4867 Adva | MBER AND TITLE nced Weapons ty Technology | & |
| (U) (U) | technologies. In FY 2005: Investigate/enhance plasma models and develop the physics algo Develop improved algorithms for higher frequency wideband HPM modeling. electromagnetic and acoustic software with thermal and electron transport code Apply virtual prototyping for HPM component technologies. | Investigate methods for integration of | | | |
| Ú) | MAJOR THRUST: Investigate HPM technologies that support offensive advar- made possible by the increased power available on future aircraft. In FY 2003: Studied enhanced source components of promise and began mode source. Determined effect of air breakdown on transmitted HPM pulse over tir of interest to determine effectual lethality of various concepts. | ling and simulation of a complete | 4.512 | 4.617 | 4.985 |
| (U) | In FY 2004: Investigate enhanced source components of promise, especially p with an integrated Marx pulser. Model and perform simulation of the complete effect of air breakdown on transmitted HPM pulse over time. Finish initial airc effects on the aircraft and command and control issues between the HPM source | e source. Complete determination of raft integration report on source | | | |
| (U) | In FY 2005: Improve the HPM effects modeling and simulation database so it model of a complete HPM source. Upgrade source models to include aircraft of source self-mitigation efforts, so as not to interfere with host platform. Begin s efforts. Complete current source component study of plastic-laminate pulse for pulser. Test source upgrades and their effect of the aircraft, as well as the comp | oncept of operations. Proceed with ource to aircraft command and control ming lines with integrated Marx | | | |
| (U) | | | | | |
| (U) | MAJOR THRUST: Further develop active denial technologies to support airbo In FY 2003: Developed computational physics algorithms for next-generation modeling sub-scale pieces of existing active denial sources to verify validity of preliminary design of a ground-based megawatt-class airborne source demonstr FY 2004 for a ground-based demonstration of airborne applicable technologies | airborne millimeter wave sources by computational approach. Developed rator. Transferred to PE 0603605F in | 0.864 | 0.000 | 0.000 |
| (U) | In FY 2004: Not Applicable. Note: Transferred to PE 0603605F for FY 2004 demonstration of airborne applicable technologies. | and out for a ground-based | | | |
| | In FY 2005: Not Applicable. | | | | |
| (U) | Total Cost | | 14.695 | 14.599 | 15.541 |
| Pro | ject 4867 R-1 Shopping | List - Item No. 12-10 of 12-11 | | Exhibit R-2a (| PE 0602605F) |
| | | 239 | | | · · · · · · |

| | UNCLASSIFIED | |
|--|---|---|
| Exhibit R-2a, RDT&E F | Project Justification | DATE February 2004 |
| UDGET ACTIVITY 2 Applied Research | PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY | PROJECT NUMBER AND TITLE 4867 Advanced Weapons & Survivability Technology |
| <u>C. Other Program Funding Summary (\$ in Millions)</u> PE 0602202F, Human Systems Technology. | | |
| PE 0603605F, Advanced Weapons Technology. This project has been coordinated through the Reliance process to har J) | rmonize efforts and eliminate duplication. | |
|) D. Acquisition Strategy Not Applicable. | | |
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| | | |
| | | |

PE NUMBER: 0602702F PE TITLE: Command Control and Communication

| BUDGF | Exhi | bit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February 2 | 2004 |
|---|---|-------------------|---------------------|---------------------|---------------------|---------------------|--|--|--|--------------------------------|
| | T ACTIVITY plied Research | | | | E NUMBER AND | | ol and Comm | unications | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| | Total Program Element (PE) Cost | 77.637 | 79.594 | 82.147 | 82.865 | 90.866 | 88.794 | 90.720 | 0.000 | 0.00 |
| 4519 | Communications Technology | 14.268 | 16.532 | 17.235 | 17.141 | 17.604 | 18.129 | 18.667 | 0.000 | 0.00 |
| 4594 | Information Technology | 23.109 | 28.600 | 25.511 | 25.557 | 28.224 | 28.610 | 28.484 | 0.000 | 0.00 |
| 4917 | Collaborative Information Tech | 15.530 | 7.746 | 5.637 | 5.197 | 5.297 | 5.456 | 5.616 | 0.000 | 0.00 |
| 5581 | Command and Control (C2) Technology | 24.730 | 26.716 | 33.764 | 34.970 | 39.741 | 36.599 | 37.953 | 0.000 | 0.00 |
| н Т | Congress added \$1.2 million for the Griff Knowledge Management for Collaborativ This program is Budget Activity 2, Appli | ve Enterprise Ma | nagement, and | \$1.0 million for | or Effects Based | | | | nillion for Secu | re |
| | echnologies. 3. Program Change Summary (\$ in Mi | illions) | | | the technical fe | easibility and m | | | and revolutiona | |
| | ecnnologies. 3. Program Change Summary (\$ in Mi | <u>illions)</u> | | | the technical fe | | | | | |
| (U) <u>F</u> | - | <u>illions)</u> | | | the technical fe | | nilitary utility o | f evolutionary <u>FY 2</u> | | ry |
| U) <u>F</u> U) (U) | 3. Program Change Summary (\$ in Mi | illions) | | | the technical fe | | nilitary utility o <u>FY 2003</u> | f evolutionary <u>FY 2</u> 71 | <u>2004</u> | ry <u>FY 2005</u> |
| U) <u>H</u> U) F U) C U) 1 | B. Program Change Summary (\$ in Mi Previous President's Budget Current PBR/President's Budget Fotal Adjustments | <u>illions)</u> | | | the technical fe | | nilitary utility o <u>FY 2003</u> 78.204 | f evolutionary <u>FY 2</u> 71 79 | <u>2004</u> .674 | ry <u>FY 2005</u> 82.764 |
| U) <u>F</u> U) F U) C U) T U) C | 3. Program Change Summary (\$ in Mi Previous President's Budget Current PBR/President's Budget Fotal Adjustments Congressional Program Reductions | <u>illions</u>) | | | the technical fe | | nilitary utility o <u>FY 2003</u> 78.204 77.637 | f evolutionary <u>FY 7</u> 71 79 7 | 2 <u>004</u> .674 .594 .920 | ry <u>FY 2005</u> 82.764 |
| U) <u>F</u> U) F U) C U) T U) C C | 3. Program Change Summary (\$ in Mi Previous President's Budget Current PBR/President's Budget Total Adjustments Congressional Program Reductions Congressional Rescissions | <u>illions</u>) | | | the technical fe | | nilitary utility o <u>FY 2003</u> 78.204 77.637 | f evolutionary <u>FY 2</u> 71 79 7 -0 | 2 <u>004</u> .674 .594 .920 .680 | ry <u>FY 2005</u> 82.764 |
| U) <u>H</u> U) F U) C U) T U) C C C | 3. Program Change Summary (\$ in Mi Previous President's Budget Current PBR/President's Budget Fotal Adjustments Congressional Program Reductions Congressional Rescissions Congressional Increases | <u>illions)</u> | | | the technical fe | | nilitary utility o <u>FY 2003</u> 78.204 77.637 | f evolutionary <u>FY 2</u> 71 79 7 -0 | 2 <u>004</u> .674 .594 .920 | ry <u>FY 2005</u> 82.764 |
| U) <u>H</u> U) F U) C U) T U) C C F | 3. Program Change Summary (\$ in Mi Previous President's Budget Current PBR/President's Budget Total Adjustments Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings | <u>illions</u>) | | | the technical fe | | nilitary utility o <u>FY 2003</u> 78.204 77.637 -0.567 | f evolutionary <u>FY 2</u> 71 79 7 -0 | 2 <u>004</u> .674 .594 .920 .680 | ry <u>FY 2005</u> 82.764 |
| U) <u>F</u> U) F U) C U) T U) C C F S | 3. Program Change Summary (\$ in Mi Previous President's Budget Current PBR/President's Budget Total Adjustments Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings SBIR/STTR Transfer | <u>illions</u>) | | | the technical fe | | nilitary utility o <u>FY 2003</u> 78.204 77.637 | f evolutionary <u>FY 2</u> 71 79 7 -0 | 2 <u>004</u> .674 .594 .920 .680 | ry <u>FY 2005</u> 82.764 |
| U) <u>F</u> U) F U) C U) T U) C C F S U) <u>S</u> | B. Program Change Summary (\$ in Mi Previous President's Budget Current PBR/President's Budget Total Adjustments Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings | <u>illions</u>) | | | the technical fe | | nilitary utility o <u>FY 2003</u> 78.204 77.637 -0.567 | f evolutionary <u>FY 2</u> 71 79 7 -0 | 2 <u>004</u> .674 .594 .920 .680 | ry <u>FY 2005</u> 82.764 |

| Exh | ibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 | |
|---|---|---|---|---|--|---|---|--|-------------------|--|
| BUDGET ACTIVITY 02 Applied Research | | | C | | | | | ROJECT NUMBER AND TITLE 519 Communications Technology | | |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| Cost (\$ III MIIIIolis) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | |
| 4519 Communications Technology | 14.268 | 16.532 | 17.235 | 17.141 | 17.604 | 18.129 | 18.667 | 0.000 | 0.000 | |
| Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| (U) <u>A. Mission Description and Budget Item</u> The Air Force requires technologies that en technologies will provide en route and dep assured connectivity with reliable, respons multi-level, secure, seamless networks; adv modular, programmable, low-cost software communications management and control, | hable assured, v loyed reachbac ive, affordable vanced commu e radios. It incl advanced com | k communicat information ex nications proce udes technolog | ions for distrib xchange via all essors; anti-jan gies for advanc | outed collaborati available comm n and low proba ced processors a | we command a nunications me bility of interco nd devices, adv | nd control (C2 dia. This proj ept techniques vanced networ | A rapidly de ect provides the ; lightweight, pl k protocols and | ployed EAF rec technologies fo hased array ante | or: ennas; and | |
| (U) <u>B. Accomplishments/Planned Program (</u> \$ | | | | | | <u>F</u> Y | <u>ř 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | |
| (U) MAJOR THRUST: Develop assured and su | | mation and net | working techn | ologies enabling | g worldwide | | 5.254 | 5.583 | 6.022 | |
| C3 operations for the Air Force Task Forces (U) In FY 2003: Developed technologies to imp Completed development of assured network critical infrastructure attacks. Developed see network services across multiple network see enable the dynamic creation of advanced inti- infrastructure devices. (U) In FY 2004: Continue to develop technolog systems (e.g., Joint Battlespace Infosphere (systems technologies to improve survivabili securely managed enterprise network techno- security domains and coalitions. Continue of area dynamic creation of advanced informati- infrastructure devices (U) In FY 2005: Continue to develop technolog information systems (e.g., JBI). Complete of to improve survivability against critical infr- network technology to develop assured network | prove quality of ting and inform curely manage ecurity domains formation delive gies to improve JBI)). Continu- ty against critic blogy to develor levelopment of cion delivery se gies to improve levelopment of astructure attac | ation systems d enterprise ne s. Developed p rery services, in quality of service developmen cal infrastructu p assured netwo programmable rvices that are quality of services assured netwo sessured netwo sessured netwo sessured netwo sessured netwo | technologies to etwork technologies programmable independent of vice for globall t of assured ne ure attacks. Co vork services a e networking a independent o vice and surviv orking and info development o | o improve survi ogy to develop a networking alge the underlying p ly distributed in tworking and in ontinue develop cross multiple r algorithms that e of the underlying vability for globa ormation system of securely man | vability against assured prithms that physical formation formation nent of etwork enable wide g physical ally distributed s technologies aged enterprise | | | | | |
| development of programmable networking a | | enable wide a | rea dynamic cr | • | ced | | | Exhibit R-2a (F | PE 0602702F) | |

| Exhibit R-2a, RDT&E | DA | TE February | 2004 | |
|--|--|----------------|-----------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602702F Command Control and Communications | | UMBER AND TITLE | chnology |
| information delivery services, independent of the underlying physic | * | | | |
| capabilities for self-organizing, self-healing, autonomous networkin (U) | lg. | | | |
| (U) MAJOR THRUST: Develop improved, higher bandwidth commun provide secure, adaptive, covert, anti-jam, and assured global battles forces while reducing the equipment footprint. | | 4.136 | 4.427 | 4.510 |
| (U) In FY 2003: Developed techniques to improve information assuran precluding information attacks aimed at denial of service and quality communication technologies that enable a full spectrum of informat a joint/coalition environment. Investigated high performance wireled improving affordability of critical Air Force command and control r | y of service degradation. Developed assured tion superiority capabilities in wireless networks in ess device and waveform technologies for | | | |
| (U) In FY 2004: Continue development of information assurance techn Global Information Grid in both wired and wireless networks for gr preclude information systems attacks, such as denial of service and develop high performance, adaptable, and re-configurable wireless of for improved robustness, security, and affordability of critical Air F development of higher performance video compression and modula high bandwidth information transmission and exploitation capabiliti | ologies that will improve the robustness of the round, air, and joint/coalition environments to degradation of device quality. Continue to devices to implement new waveform technologies Force command and control networks. Initiate tion techniques that enable critical objectives for ies over wireless channels. | | | |
| (U) In FY 2005: Continue development of information assurance techn Information Grid in both wireline and wireless networks for air, spa preclude information systems attacks such as distributed denial of se to develop high performance, adaptable, and reconfigurable wireless technologies for improved robustness, security, and affordability of Continue development of higher performance video compression an objectives for high bandwidth information transmission and exploit the feasibility of implementation of above technologies, where appli- compatible software radios. | ace, ground, and joint/coalition environments to ervice and degradation of device quality. Continue s devices to implement new waveform critical Air Force command and control networks. nd modulation techniques that enable critical ation capabilities over wireless channels. Explore | | | |
| (U) (U) MAJOR THRUST/CONGESSIONAL ADD: Develop cyber operate command, control, communications and intelligence. Note: This effective command. | | 4.878 | 6.522 | 6.703 |
| Congressional Add funding for the Griffiss Institute. (U) In FY 2003: Developed automated capabilities for damage assessm computer and network forensics tools and data mining tools to asses Developed detection and eradication techniques for malicious softw | ss coordinated information warfare attacks. | | | |
| | R-1 Shopping List - Item No. 13-3 of 13-15 | | Exhibit R-2a (F | PE 0602702F) |
| | 243 | | | |

| | Evhibit P. | | Project lus | tification | | | DAT | Ē | | |
|---|---|--|-----------------------------------|--|-----------------------------------|-----------------------------------|----------------------------|--|-------------------|--|
| | | za, RDIQE | Project Jus | | | | | February 2004 | | |
| BUDGET ACTIVITY 02 Applied Research | | | | PE NUMBER A 0602702F C Communica | ommand Con | trol and | | DJECT NUMBER AND TITLE 19 Communications Technology | | |
| detection of hidden data, and early assessment of complex information warfare attacks. (U) In FY 2004: Continue to develop automated capabilities for damage assessment and recovery techniques. Continue development of network forensics and data mining tools for detecting adversary information warfare attacks and to provide early warning notification. Continue to develop detection and eradication techniques for malicious code. Continue development of active response technologies. Complete work in detection and leadication techniques to action analysis. Initiate the development of active response technologies, and information systems, and allow for integration of coalition information elements. (U) In FY 2005: Continue to develop automated capabilities for damage assessment and recovery techniques. Complete development of network forensics. Continue development of data mining tools for detecting adversary information warfare attacks and information elements. (U) In FY 2005: Continue to develop automated capabilities for damage assessment and recovery techniques. Complete development of network forensics. Continue development of data mining tools for detecting adversary information warfare attacks and provide early warning notification. Continue to develop detection and eradication techniques for malicious code. Continue development of active response technologies. Continue development of intrusion detection techniques for wireless networks. Continue the development of tools and techniques to protect C4I and information systems and allow for integration of coalition information elements. | | | | | | | | | | |
| (U) Total Cost | | | | | | | 14.268 | 16.532 | 17.235 | |
| (U) <u>C. Other Program Funding Su</u> | <u>mmary (\$ in Millio</u> <u>FY 2003</u> <u>Actual</u> | <u>ons)</u> <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> Estimate | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> | |
| (U) Related Activities: (U) PE 0603789F, C3I Advanced Development. This project has been coordinated through the | | | | | | | | | | |
| (U) Reliance process to harmonize efforts and eliminate duplication. | | | | | | | | | | |
| (U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | | | | | | | |
| Project 4519 | | R | -1 Shopping List - | Item No. 13-4 of 1 244 | 3-15 | | | Exhibit R-2a | (PE 0602702F) | |

| | ExI | hibit R-2a, F | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 | |
|-------------------|--|---|--|---|--|---|---|--|--|------------------------------------|--|
| | GET ACTIVITY pplied Research | | | c | | | | | ROJECT NUMBER AND TITLE 594 Information Technology | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | |
| 4594 | | 23.109 | 28.600 | 25.511 | 25.557 | 28.224 | 28.610 | | 0.000 | 0.000 | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| (U) | A. Mission Description and Budget Iter The Air Force requires technologies that information. This project improves global and precision needed to accomplish their information is fused to support the dynamic global information base for continued use affordable manner and include appropriate | improve and aut awareness at a missions. Glob nic planning and and historical a | Il levels, enabl al awareness is execution cyc nalysis. The i | ling warfighter s achieved by e le via the globa nformation tec | s to understand exploiting inform al information e hnologies requi | relevant militan nation provideo nterprise. Kno | ry situations of l by the Air Fo wledge, inform | n a consistent ba orce and other go nation, and data | asis, with the tin overnment agen are all archived | neliness icies. The l in the | |
| (U) | B. Accomplishments/Planned Program (| (\$ in Millions) | | | | | F١ | <u> 7 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | |
| | MAJOR THRUST: Develop innovative m | | aborative fusio | n technologies | in a fully distri | buted air and | <u>.</u> | 5.538 | 6.637 | 6.813 | |
| (U) (U) (U) | space environment. In FY 2003: Developed techniques to quartechniques for continuous tracking of milit fusion technologies for enemy threat prediction FY 2004: Continue to develop technique a new emerging information era. Continue tracking of militarily significant vehicles in technologies for enemy threat prediction the In FY 2005: Evaluate fusion techniques to analysis of a new emerging information era positive identification and continuous track development and evaluation of fusion tech fusion. | arily significant ction based on r les to quantitative development of n the battlespace mough the use of determine opti a. Continue to o king of militarily | vehicles in the nulti-source fu vely evaluate fu f optimized mu c. Continue de f multi-source mal algorithms levelop optimi y significant ve | e battlespace. I sion. usion algorithm ulti-source fusi velopment and fusion. s based upon da zed multi-sour- chicles in the ba | Developed and ns that support to on techniques for evaluation of for ata available that ce fusion techniattlespace. Con | evaluated he analysis of or continuous usion t support the ques for tinue | | | | | |
| (U) | MAJOR THRUST: Develop higher level i achieve situational awareness at all comma In FY 2003: Developed intermediate infor time allocated to analysis and decision-mal techniques for a self-organizing, data repos | and levels for th mation extraction king, enabling t | e dynamic plar on techniques t ne ability to po | nning and exec that will reduce pulate knowle | ution process. e data overload dge base system | and increase as. Developed | | 4.612 | 5.531 | 5.694 | |
| Proj | ect 4594 | | R-1 Sh | opping List - Iten | n No. 13-5 of 13-1 | 5 | | | Exhibit R-2a (F | PE 0602702F) | |
| | | | | 244 | - | | | | | | |

| | Exhibit R-2a, RDT&E | DATE February 2004 | | | | |
|---|--|---|---------------|-----------------|--------------|--|
| (U) In FY 2004: Čontinue development of intermediate information extraction techniques to reduce data overhaad and increase time allocated to analysis and decision-making, enabling the ability to populate knowledge base systems. Continue development of advanced web-based search techniques, data filtering techniques, and information aggregation methods required for rapid situational understanding. (U) In FY 2005: Continue development of intermediate information extraction techniques to decrease analysis time for decision-making and enabling the ability to populate knowledge base systems. Continue development of intermediate information extraction to support identification of potential events in the world. Continue development of extraction to support identification of potential events in the world. Continue development of available data on the Web required for rapid situational understanding. (U) MAOR THRUST: Develop automatic and dynamically reconfigurable, affordable, scalable, distributed petaflop 2.886 3.606 3.948 processing technologies for real-time enomy, construct-addressable architecture for rapid extraction of information from globally distributed knowledge bases. Evaluated architecture to support real-time requirements for dominant battlespace awareness. Initiate study of next generation information technologies (e.g., quantum computing and bio-molecular computing) for C2 systems. (U) In FY 2004: Develop and demonstrate architectures to support real-time requirements for dominant battlespace suverness. Unitate study of next generation information technologies (e.g., quantum computing and bio-molecular computing) for C2 systems. (U) In FY 2005: Demonstrate architectures for rapid extraction of planning, execution, and assessment environments. (U) In FY 2005: Evaluated, exploited, and developed model abstraction and multi-resolution modeling techniques to reduce chorelogies to reduce the complexity of existing high-resolution | BUDGET ACTIVITY 02 Applied Research | 0602702F Command Control and | | | | |
| decision-making and enabling the ability to populate knowledge base systems. Continue development of data mining techniques for self-organizing data repositories and content-based extraction to support identification of potential events in the world. Continue development of web-based search techniques, and information aggregation methods to take advantage of the explosion of available data on the Web required for rapid situational understanding. (U) (U) (U) MAJOR THRUST: Develop automatic and dynamically reconfigurable, affordable, scalable, distributed petaflop 2.886 3.606 3.948 processing technologies for real-time command and control (C2) global information systems. (U) In FY 2003: Completed the processor-in-memory, content-addressable architecture for rapid extraction of information from globally distributed knowledge bases. Evaluated architecture to support real-time requirements for dominant battlespace awareness. Initiate study of next generation information technologies (e.g., quantum computing and bio-molecular computing) for C2 systems. (U) In FY 2005: Demonstrate architecture for rapid extraction of information from globally distributed knowledge bases. Continue evaluation of information from globally distributed knowledge bases. Initiate study of next generation information technologies (e.g., quantum computing and bio-molecular computing) for C2 systems. (U) In FY 2005: Develop modeling and simulation technologies for the next generation of planning, execution, and assessment environments. (U) In FY 2003: Evaluated, exploited, and developed model abstraction and multi-resolution modeling techniques to resisting high-resolution models and simulations for next generation distributed collaborative decision support environments. Initiate development of decision support technologies, and their theoretical foundation, to support environments. Initiate development of decision support technologies, and their theoretical foundation, to | (U) In FY 2004: Continue development of intermediate information ex- increase time allocated to analysis and decision-making, enabling the Continue development of data mining techniques for a self-organizi support prediction of potential events in the world. Continue development | raction techniques to reduce data overload and the ability to populate knowledge base systems. Ing data repository and content-based extraction to opment of advanced web-based search techniques, | | | | |
| (U) MAJOR THRUST: Develop automatic and dynamically reconfigurable, affordable, scalable, distributed petaflop processing technologies for real-time command and control (C2) global information systems. (U) In FY 2003: Completed the processor-in-memory, content-addressable architecture for rapid extraction of information from globally distributed knowledge bases. Evaluated architecture to support real-time requirements for dominant battlespace awareness. (U) In FY 2004: Develop and demonstrate architectures for rapid extraction of information from globally distributed knowledge bases. Initiate study of next generation information technologies (e.g., quantum computing and bio-molecular computing) for C2 systems. (U) In FY 2005: Demonstrate architecture for rapid extraction of information from globally distributed knowledge bases. Demonstrate architecture for rapid extraction of information from globally distributed showledge bases. Demonstrate architecture for rapid extraction of information form globally distributed showledge bases. Demonstrate architecture for rapid extraction of information from globally distributed showledge bases. Demonstrate architecture for rapid extraction of information form globally distributed showledge bases. U(U) (U) In FY 2005: Develop modeling and simulation technologies for the next generation of planning, execution, and assessment environments. (U) In FY 2003: Evaluated, exploited, and developed model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments. Initiate development of decision support technologies, and their theoretical foundation, to support environments. | decision-making and enabling the ability to populate knowledge bas techniques for self-organizing data repositories and content-based e events in the world. Continue development of web-based search techniformation aggregation methods to take advantage of the explosion | se systems. Continue development of data mining straction to support identification of potential chniques, data filtering techniques, and | | | | |
| processing technologies for real-time command and control (C2) global information systems. (U) In FY 2003: Completed the processor-in-memory, content-addressable architecture for rapid extraction of information from globally distributed knowledge bases. Evaluated architecture to support real-time requirements for dominant battlespace awareness. (U) In FY 2004: Develop and demonstrate architectures for rapid extraction of information from globally distributed knowledge bases. Continue evaluation of architectures to support real-time requirements for dominant battlespace awareness. Initiate study of next generation information technologies (e.g., quantum computing and bio-molecular computing) for C2 systems. (U) In FY 2005: Demonstrate architecture for rapid extraction of information from globally distributed knowledge bases. Demonstrate architecture to support real-time requirements for dominant battlespace awareness. Continue study of next generation information technologies for the next generation of planning, execution, and assessment environments. (U) In FY 2003: Evaluated, exploited, and developed model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments, such as the Joint Synthetic Battlespace. (U) In FY 2004: Complete model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments. Initiate development of decision support technologies, and their theoretical foundation, to support | | | 2 00 f | 2 60 6 | 2 0 4 0 | |
| (U) In FY 2003: Completed the processor-in-memory, content-addressable architecture for rapid extraction of information from globally distributed knowledge bases. Evaluated architecture to support real-time requirements for dominant battlespace awareness. (U) In FY 2004: Develop and demonstrate architectures to support real-time requirements for dominant battlespace awareness. Initiate study of next generation information technologies (e.g., quantum computing and bio-molecular computing) for C2 systems. (U) In FY 2005: Demonstrate architecture for rapid extraction of information from globally distributed knowledge bases. Demonstrate architecture for rapid extraction of information from globally distributed knowledge bases. Continue study of next generation information technologies (e.g., quantum computing) for C2 systems. (U) In FY 2005: Demonstrate architecture for rapid extraction of moments battlespace awareness. Continue study of next generation information technologies for the next generation of planning, execution, and assessment environments. (U) In FY 2003: Evaluated, exploited, and developed model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments. Initiate development of decision support technologies, and their theoretical foundation, to support | | · · | 2.886 | 3.606 | 3.948 | |
| (U) In FY 2004: Develop and demonstrate architectures for rapid extraction of information from globally distributed knowledge bases. Continue evaluation of architectures to support real-time requirements for dominant battlespace awareness. Initiate study of next generation information technologies (e.g., quantum computing and bio-molecular computing) for C2 systems. (U) In FY 2005: Demonstrate architecture for rapid extraction of information from globally distributed knowledge bases. Demonstrate architecture to support real-time requirements for dominant battlespace awareness. Continue study of next generation information technologies (e.g., quantum computing) for C2 systems. (U) In FY 2005: Demonstrate architecture to support real-time requirements for dominant battlespace awareness. Continue study of next generation information technologies (e.g., quantum computing) for C2 systems. (U) MAJOR THRUST: Develop modeling and simulation technologies for the next generation of planning, execution, and assessment environments. (U) In FY 2003: Evaluated, exploited, and developed model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments, such as the Joint Synthetic Battlespace. (U) In FY 2004: Complete model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments. Initiate development of decision support technologies, and their theoretical foundation, to support | (U) In FY 2003: Completed the processor-in-memory, content-address information from globally distributed knowledge bases. Evaluated | able architecture for rapid extraction of | | | | |
| Demonstrate architecture to support real-time requirements for dominant battlespace awareness. Continue study of next generation information technologies (e.g., quantum computing and bio-molecular computing) for C2 systems. MAJOR THRUST: Develop modeling and simulation technologies for the next generation of planning, execution, and assessment environments. In FY 2003: Evaluated, exploited, and developed model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments, such as the Joint Synthetic Battlespace. In FY 2004: Complete model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolution modeling techniques to reduce the complexity of existing high-resolution modeling techniques to reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments. Initiate development of decision support technologies, and their theoretical foundation, to support | (U) In FY 2004: Develop and demonstrate architectures for rapid extra knowledge bases. Continue evaluation of architectures to support re awareness. Initiate study of next generation information technologi | eal-time requirements for dominant battlespace | | | | |
| (U) MAJOR THRUST: Develop modeling and simulation technologies for the next generation of planning, execution, and assessment environments. (U) In FY 2003: Evaluated, exploited, and developed model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments, such as the Joint Synthetic Battlespace. (U) In FY 2004: Complete model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolution modeling techniques to reduce the complexity of existing high-resolution and multi-resolution modeling techniques to reduce the complexity of existing high-resolution and multi-resolution modeling techniques to reduce the complexity of existing high-resolution and multi-resolution modeling techniques to reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments. Initiate development of decision support technologies, and their theoretical foundation, to support | Demonstrate architecture to support real-time requirements for dom | inant battlespace awareness. Continue study of | | | | |
| and assessment environments. (U) In FY 2003: Evaluated, exploited, and developed model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments, such as the Joint Synthetic Battlespace. (U) In FY 2004: Complete model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolutions for next generation distributed collaborative decision support environments. Initiate development of decision support technologies, and their theoretical foundation, to support | | 1 0/ 2 | | | | |
| reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments, such as the Joint Synthetic Battlespace. (U) In FY 2004: Complete model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments. Initiate development of decision support technologies, and their theoretical foundation, to support | | for the next generation of planning, execution, | 2.908 | 1.916 | 2.006 | |
| (U) In FY 2004: Complete model abstraction and multi-resolution modeling techniques to reduce the complexity of existing high-resolution models and simulations for next generation distributed collaborative decision support environments. Initiate development of decision support technologies, and their theoretical foundation, to support | reduce the complexity of existing high-resolution models and simul | ations for next generation distributed collaborative | | | | |
| Project 4594 R-1 Shopping List - Item No. 13-6 of 13-15 Exhibit R-2a (PE 0602702F) | (U) In FY 2004: Complete model abstraction and multi-resolution mod existing high-resolution models and simulations for next generation | eling techniques to reduce the complexity of distributed collaborative decision support | | | | |
| | Project 4594 F | R-1 Shopping List - Item No. 13-6 of 13-15 | | Exhibit R-2a (F | PE 0602702F) | |

| DEDECT ACTIVITY IFE NUMBER AND TITLE PROJECT NUMBER AND TITLE 02 Applied Research Image: Communications 4594 Information Technology 1 high-profile system concepts, such as the Joint Synthetic Buttlespace and the Global Strike Task. Force. 1 1 1 Dig TY 2005: Continue to develop modeling and simulation technologies to support technologies for course of action assessment and prediction. Prototype and demonstrate decision support technologies for course of action assessment and prediction. Prototype and demonstrate decision support technologies for course of action assessment and prediction. Prototype and demonstrate decision support technologies for clectronic communications and special signals intelligence, imagery and measurement signatures to increase accuracy, correlation and finedimies of the information value to the decision maker. Note: This effort includes 54.10 million in FY 2004. Congressional Add funding for Measurement and signature Intelligence Warfighter Visualization Tools. 5.766 10.910 7.050 (1) In FY 2004. Continue development of advanced multi-sensor open systems techniques and automated analyst tools for exploiting hyperspectral imagery, on-board video processing, new electronic signals, moving target indicator, and speech intelligence products for information relieves in steganography, steganalysis, and analyst tools divide and warning, and reporting capabilities. Research techniques in steganography, steganalysis, watermarking of imagery, video and speech intelligence products for exploiting measurement and signature indicator, and speech information protection and automated analyst tools for exploiting measurement and signature indicator, and speech information | | Exhibit R-2a, RDT&E Projec | DATE February 2004 | | | |
|---|-----|---|--|-------|-----------------|--------------|
| (U) In FY 2005: Continue to develop modeling and simulation technologies to support next generation planning execution and assessment environments. Develop adversarial behavior models and modeling techniques for course of action assessment and prediction. Prototype and demonstrate decision support technologies and the theoretical foundation to support high-profile system concepts; such as the Joint Synthetic Battlespace and Air Force Concepts of Operations. (U) (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop digital information exploitation technologies for electronic contractions and special signals intelligence, imagery and measurement signatures to increase accuracy, correlation and timeliness of the information value to the decision maker. Note: This effort includes \$4.0 million in FY 2004 Congressional Add funding for Measurement al Signature Intelligence Warfighter Visualization Tools. (U) In FY 2003: Developed advanced multi-sensor open systems techniques and automated analyst tools for exploiting hyperspectral imagery, on-board video processing, new electronic signals, and speech intelligence products to achieve improved situational awareness. (U) In FY 2004: Continue development of advanced multi-sensor open systems techniques in steganography, steganalysis, and watermarking of imagery, video and speech for information protection and authentication, intelligence cryptored situational awareness, indication and warning, and reporting capabilities. Research techniques in steganography, steganalysis, and watermarking of dimagery, video and speech intelligence products to for sproved situational awareness, indication, and analysti tool aids. (U) In FY 2005: Continue development of advanced multi-sensor and automated analyst tools for exploiting measurement and signature intelligence to products to feed an information fusion processing, new digital electronic signals, moving traget indicators, and speech intelligence products to feed an informati | | | 0602702F Command Control and | | JMBER AND TITLE | |
| (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop digital information exploitation technologies for electronic 5.766 10.910 7.050 communications and special signals intelligence, imagery and measurement signatures to increase accuracy, correlation and timeliness of the information value to the decision maker. Note: This effort includes \$4.0 million in FY 2004 Congressional Add funding for Measurement and Signature Intelligence Warfighter Visualization Tools. (U) In FY 2003: Developed advanced multi-sensor open systems techniques and automated analyst tools for exploiting hyperspectral imagery, on-board video processing, new electronic signals, moving target indicator, and speech intelligence products to achieve improved situational awareness, indication and warming, and reporting capabilities. Research techniques in steganography, steganalysis, and watermarking of imagery, video and speech intelligence products to for exploiting measurement and signature intelligence, and automated analyst tools for exploiting measurement and signature intelligence and untertesting protection and authentication, intelligence exploitation, and analysis tool aids. (U) In FY 2005: Continue development of advanced multi-sensor and automated analyst tools for exploiting measurement and signature intelligence, and speech intelligence products to feed an information fusion process in support of the decision maker. Continue development of techniques in steganography, steganalysis, watermarking and tigital data forensies for information protection and authentication, intelligence exploitation, and analyst tool aids. (U) In FY 2003: Developed information protection and Authentication. (U) CONGRESSIONAL ADD: Information Protection and Authentication. (U) In FY 2003: Developed information systems. Developed and evaluated steganographic detection, decoding, and countermeasure techniques for data embedding, tamper detection and proofing, ima | | In FY 2005: Continue to develop modeling and simulation technologies to se execution and assessment environments. Develop adversarial behavior mode action assessment and prediction. Prototype and demonstrate decision suppor foundation to support high-profile system concepts; such as the Joint Syntheter | support next generation planning els and modeling techniques for course of ort technologies and the theoretical | | | |
| (U) In FY 2003: Developed advanced multi-sensor open systems techniques and automated analyst tools for exploiting hyperspectral imagery, on-board video processing, new electronic signals, and speech intelligence products to achieve improved situational awareness. (U) In FY 2004: Continue development of advanced multi-sensor open systems techniques and automated analyst tools for exploiting measurement and signature intelligence, hyperspectral imagery, on-board video processing, new electronic signals, moving target indicator, and speech intelligence products for improved situational awareness, indication and warning, and reporting capabilities. Research techniques in steganography, steganalysis, and watermarking of imagery, video and speech for information protection and authentication, intelligence exploitation, and analysis tool aids. (U) In FY 2005: Continue development of advanced multi-sensor and automated analyst tools for exploiting measurement and signature intelligence, commercial sources and hyperspectral imagery, on-board video processing, new digital electronic signals, moving target indicator, and speech intelligence products to feed an information fusion process in support of the decision maker. Continue development of rechniques in steganography, steganalysis, watermarking and digital data forensics for imagery, video and speech information protection and authentication, intelligence exploitation, and analysts' tool aids. Itilitie investigation of new techniques to improve open systems techniques for multi-sensor exploitation for enhanced indications and warning and situational awareness. (U) CONGRESSIONAL ADD: Information Protection and Authentication. (U) In FY 2003: Developed information hystems. Developed and evaluated steganographic detection, decoding, and countermeasure techniques for data embedding, tamper detection and proofing, image and video content authenticate data within Air Force and DoD information dissemination. | | communications and special signals intelligence, imagery and measurement s correlation and timeliness of the information value to the decision maker. No | signatures to increase accuracy, ote: This effort includes \$4.0 million in | 5.766 | 10.910 | 7.050 |
| (U) In FY 2004: Continue development of advanced multi-sensor open systems techniques and automated analyst tools for exploiting measurement and signature intelligence, hyperspectral imagery, on-board video processing, new electronic signals, moving target indicator, and speech intelligence products for improved situational awareness, indication and warning, and reporting capabilities. Research techniques in steganography, steganalysis, and watermarking of imagery, video and speech for information protection and authentication, intelligence exploitation, and analysis tool aids. (U) In FY 2005: Continue development of advanced multi-sensor and automated analyst tools for exploiting measurement and signature intelligence, commercial sources and hyperspectral imagery, on-board video processing, new digital electronic signals, moving target indicator, and speech intelligence products to feed an information fusion process in support of the decision maker. Continue development of techniques in steganography, steganalysis, watermarking and digital data forensics for imagery, video and speech information protection and authentication, intelligence exploitation, and analysts' tool aids. Initiate investigation of new techniques to improve open systems techniques for multi-sensor exploitation for enhanced indications and warning and situational awareness. (U) (U) CONGRESSIONAL ADD: Information Protection and Authentication. (U) In FY 2003: Developed information systems. Developed and evaluated steganographic detection, decoding, and countermeasure techniques for data embedding, tamper detection and proofing, image and video content authentication, and secure information. | (U) | In FY 2003: Developed advanced multi-sensor open systems techniques and hyperspectral imagery, on-board video processing, new electronic signals, and | d automated analyst tools for exploiting | | | |
| (U) In FY 2005: Continue development of advanced multi-sensor and automated analyst tools for exploiting measurement and signature intelligence, commercial sources and hyperspectral imagery, on-board video processing, new digital electronic signals, moving target indicator, and speech intelligence products to feed an information fusion process in support of the decision maker. Continue development of techniques in steganography, steganalysis, watermarking and digital data forensics for imagery, video and speech information protection and authentication, intelligence exploitation, and analysts' tool aids. Initiate investigation of new techniques to improve open systems techniques for multi-sensor exploitation for enhanced indications and warning and situational awareness. (U) (U) CONGRESSIONAL ADD: Information Protection and Authentication. (I) In FY 2003: Developed information hiding, steganography, and digital watermarking to protect and authenticate data within Air Force and DoD information systems. Developed and evaluated steganographic detection, decoding, and countermeasure techniques for data embedding, tamper detection and proofing, image and video content authentication, and secure information dissemination. | (U) | In FY 2004: Continue development of advanced multi-sensor open systems is for exploiting measurement and signature intelligence, hyperspectral imagery electronic signals, moving target indicator, and speech intelligence products a indication and warning, and reporting capabilities. Research techniques in st watermarking of imagery, video and speech for information protection and an | y, on-board video processing, new for improved situational awareness, teganography, steganalysis, and | | | |
| (U) CONGRESSIONAL ADD: Information Protection and Authentication. (U) In FY 2003: Developed information hiding, steganography, and digital watermarking to protect and authenticate data within Air Force and DoD information systems. Developed and evaluated steganographic detection, decoding, and countermeasure techniques for data embedding, tamper detection and proofing, image and video content authentication. | (U) | In FY 2005: Continue development of advanced multi-sensor and automated measurement and signature intelligence, commercial sources and hyperspectra new digital electronic signals, moving target indicator, and speech intelligence process in support of the decision maker. Continue development of technique watermarking and digital data forensics for imagery, video and speech inform intelligence exploitation, and analysts' tool aids. Initiate investigation of new | ral imagery, on-board video processing, ce products to feed an information fusion les in steganography, steganalysis, mation protection and authentication, w techniques to improve open systems | | | |
| (U) In FY 2003: Developed information hiding, steganography, and digital watermarking to protect and authenticate data within Air Force and DoD information systems. Developed and evaluated steganographic detection, decoding, and countermeasure techniques for data embedding, tamper detection and proofing, image and video content authentication, and secure information dissemination. | (U) | | | | | |
| (I) In FY 2004: Not Applicable | (U) | In FY 2003: Developed information hiding, steganography, and digital water within Air Force and DoD information systems. Developed and evaluated ste countermeasure techniques for data embedding, tamper detection and proofin authentication, and secure information dissemination. | teganographic detection, decoding, and | 1.399 | 0.000 | 0.000 |
| | | In FY 2004: Not Applicable. | | | | |
| Project 4594 R-1 Shopping List - Item No. 13-7 of 13-15 Exhibit R-2a (PE 0602702F) 247 247 | Pro | ject 4594 R-1 Shoppi | | | Exhibit R-2a (F | PE 0602702F) |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|--|---------------------------------|---|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-------------------|
| BUDGET ACTIVITY 02 Applied Research | | PROJECT NUMBER AND TITLE 4594 Information Technology | | | | | | | |
| (U) In FY 2005: Not Applicable.(U) Total Cost | | | | • | | | 23.109 | 28.600 | 25.511 |
| (U) <u>C. Other Program Funding Sumn</u> | • | | | | | | | | |
| (U) Related Activities: PE 0603789F, C3I Advanced Development. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| (U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | | | | | | |
| Project 4594 | | F | | <u>Item No. 13-8 of 1</u> 248 | 3-15 | | | Exhibit R-2a | PE 0602702F |

| | Ex | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|------|--------------------------------|---------------|-----------|-------------|---|-------------|----------|---|----------|-------|
| | T ACTIVITY plied Research | | | C | PE NUMBER AND 0602702F Con Communicatio | nmand Contr | | PROJECT NUMBER AND TITLE 4917 Collaborative Information Tech | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ In Winnons) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | I |
| 4917 | Collaborative Information Tech | 15.530 | 7.746 | 5.637 | 5.197 | 5.297 | 5.456 | 5.616 | 5 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | C | | 1 |
| | | | | | | | | | | |

(U) A. Mission Description and Budget Item Justification

To implement the Global Strike Task Force and other task force concepts, the Air Force requires a distributed, collaborative command and control (C2) system, allowing the majority of the C2 center to remain in the continental United States, while only a small command element is deployed forward. This project accomplishes the initial exploration of high payoff emerging technologies for the next generation of distributed collaborative C2 systems. This program develops technologies for platform connectivity, distributed collaboration, and embedded information systems. Platform connectivity technologies focus on advanced modulation waveforms for bandwidth efficiency, assured aerospace platform connectivity for C2, and conceptual design approaches for seamless integration of aerospace weapon systems into the information grid. Distributed collaboration technologies advance collaboration science, virtual environments, and predictive simulation tools to facilitate the development and fielding of next generation of distributed information architectures, which will provide cross disciplinary products/capability to a decision maker when, where, and how it is needed. It also provides embedded information system technologies for affordable and adaptable design and development of complex C2 systems, facilitated by an open system architecture approach.

| (U) | B. Accomplishments/Planned Program (\$ in Millions) | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
|-----|---|----------------|----------------|----------------|
| (U) | MAJOR THRUST: Develop critical information transmission technologies to permit the seamless integration of | 1.808 | 1.989 | 2.012 |
| | aerospace weapon systems' C2, intelligence, surveillance, and reconnaissance data/information. | | | |
| (U) | In FY 2003: Developed assured secure communications technology, leveraging the commercial infrastructure, for | | | |
| | positive C2 of aerospace assets in civilian airspace. Developed secure, wide-band wireless information transfer | | | |
| | technology for assured communications between munitions and aircraft. | | | |
| (U) | In FY 2004: Continue the development of assured communications technology, leveraging commercial infrastructure, | | | |
| | for positive C2 of aerospace assets in commercial airspace. Continue the development of secure, wide-band wireless | | | |
| | miniaturized transceiver information transfer technology for assured communications between munitions and aircraft. | | | |
| (U) | In FY 2005: Continue the development of assured communications technology, leveraging commercial infrastructure, | | | |
| | for positive command and control of aerospace assets in commercial airspace. Complete the design and development | | | |
| | of secure, wide-band wireless miniaturized transceiver information transfer technology for assured communications | | | |
| | between munitions and aircraft. Develop, test, and assess exploratory information transfer technologies. | | | |
| (U) | | | | |
| (U) | MAJOR THRUST: Develop processes, methods, and techniques to provide assured performance, integrity, and | 2.533 | 1.388 | 1.505 |
| | security of real-time embedded information systems. | | | |
| (U) | In FY 2003: Developed dynamically reconfigurable aerospace systems using adaptive computing techniques. | | | |
| Pro | oject 4917 R-1 Shopping List - Item No. 13-9 of 13-15 | | Exhibit R-2a (| PE 0602702F) |
| | 249 | | | |

| Exhibit R-2a, RDT&E Proj∉ | ect Justification | DAT | [™] February : | 2004 |
|--|--|-------|-----------------------------------|--------------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602702F Command Control and Communications | | MBER AND TITLE borative Inform | |
| Developed concepts, designs, and models for the next generation C2 global affordable design and development of highly complex aerospace systems. determining the suitability of Java and Real-Time Java to support open syst information systems. | Developed methods and processes for | | | |
| (U) In FY 2004: Continue to develop dynamically reconfigurable aerospace sy techniques. Define and develop algorithms, methods, and processes to sup management of system resources across multiple tactical platforms. | | | | |
| (U) In FY 2005: Continue development of dynamically reconfigurable aerospaties techniques. Continue to develop algorithms, methods, and processes to sup- management of system resources across multiple tactical platforms. Develop implementation of Java and Real-Time Java Virtual Machines using adapti- | oport real-time, adaptive resource op methods and processes for | | | |
| (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop advanced information support, knowledge management, and rapid adaptation/re-allocation of asset threat environment. Note: This effort includes \$3.5 million in FY 2003 Construction | tion technologies for collaborative decision ets in response to the continually changing ongressional Add funding for Secure | 7.728 | 4.369 | 2.120 |
| Knowledge Management and \$2.4 million in FY 2004 Congressional Add in Management for Collaborative Enterprise Management. (U) In FY 2003: Investigated techniques to perform the collaborative planning Operations (AF CONOPS). Developed distributed decision-making technology to support a sensor-to-shooter scenari requirement, which will result in denying the enemy the sanctuary of time. | for the seven Air Force Concepts of ology for joint battlespace information | | | |
| (U) In FY 2004: Develop techniques to assist in performing the collaborative p Initiate development of distributed collaborative environment technology for battlespace awareness. Continue to develop technology to support a sensor target requirement, which will deny the enemy sanctuary of time. | or effects-based operations and predictive | | | |
| (U) In FY 2005: Continue development of techniques to perform collaborative seven AF CONOPS. Continue development of distributed collaborative en operations and predictive battlespace awareness. Complete work to develo scenario stressing time-critical target requirement, which will deny the energy | vironment technology for effects based p technology to support a sensor-to-shooter | | | |
| (U) (U) CONCRESSIONAL ADD: Agila Passarch and Davalonment/Science and | Technology Conter of Excellance | 3.461 | 0.000 | 0.000 |
| (U) CONGRESSIONAL ADD: Agile Research and Development/Science and (U) In FY 2003: Developed simulation-based acquisition (SBA) technologies a systems design and analysis. Developed an enhanced collaborative technol SBA. Demonstrated the enhanced architecture in an experiment for collaborative for collaborative enhanced architecture in an experiment for collaborative enhanced e | for application to integrated aerospace ogy architecture supporting the tenets of | 5.401 | 0.000 | 0.000 |
| Project 4917 R-1 Shop | bing List - Item No. 13-10 of 13-15 | | Exhibit R-2a (F | PE 0602702F) |

| Ex | hibit R-2a, | RDT&E P | roject Just | ification | | | | DATE February | 2004 |
|---|-----------------|---------------------------|---------------------|----------------------------|-----------------------------------|---|---------------|---|-------------------|
| BUDGET ACTIVITY D2 Applied Research | | | | | | PROJECT NUMBER AND TITLE 4917 Collaborative Information Tec | | | |
| based planning.U) In FY 2004: Not Applicable.U) In FY 2005: Not Applicable.U) Total Cost | | | | | | | 15.530 | 7.746 | 5.637 |
| | <u>7 2003 F</u> | <u>Y 2004</u> Estimate | FY 2005 Estimate | <u>FY 2006</u> Estimate | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> Estimate | FY 2 Estin | 2009 <u>Cost to</u> mate <u>Complete</u> | <u>Total Cost</u> |
| Project 4917 | | R-1 \$ | | em No. 13-11 of 13 | 3-15 | | | Exhibit R-2a (| PE 06027021 |

| | Ex | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|---------------------------------------|---|--|--|--|--|--|--|--|---|--|
| | ET ACTIVITY pplied Research | Q | PE NUMBER AND 602702F Con Communicatio | nmand Contr | ol and | PROJECT NUMBER AND TITLE 5581 Command and Control (C2) Technology | | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 5581 | Technology | 24.730 | 26.716 | 33.764 | 34.970 | 39.741 | 36.599 | | 0.000 | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U)] | information for real-time, distributed bat systems and infrastructure. Technology information management and distribution systems. Advances in the ability to detect development of various courses of action create new knowledge are needed by the reconfiguration of C2 centers to respond distribution technologies will ensure the B. Accomplishments/Planned Program | development in t n services. Adva ct, classify, ident n to counter their Expeditionary A to varying crisis delivery of high- | his project foc inces in plannin ify, and track of intentions. Ac erospace Forc levels, as requ | uses on plannin ng and assessmo objects and eve dvances in the of e. Advances ir hired, by the Ex | ng and assessing eent technologie nts will improv development of a distributed int peditionary Ae | g techniques, k es will vastly in e the understan very large con elligent inform rospace Force. | nowledge base pprove the mil ding and pred pprehensive kr ation systems Advances in | es, distributed in litary decision m iction of enemy nowledge bases will allow autom | formation system aking process v intentions, allo to rapidly form natic rapid | ems, and within C2 wing the ulate and |
| (U) 1 (U) 1 (U) 1 i (U) 1 | MAJOR THRUST: Investigate and devel generation knowledge bases for aerospace In FY 2003: Developed tools that will au for discovering relevant linkages between inferencing and performance of C2 system In FY 2004: Continue to develop tools the link patterns for discovering relevant linka | lop technologies e C2 systems. tomate intelligen entities. Develo ns. at will automate | t extraction, co ped enhanced the intelligent | orrelation, and reasoning tech extraction, corr | classification of niques for comp relation, and cla | f link patterns plex assification of | | 4.930 | 6.576 | 7.393 |
| i (U)] | Information repositories and associated preasoning techniques for complex inference In FY 2005: Investigate and develop tech knowledge bases for aerospace C2 system correlation and classification of link patter development of ultra-large all-source info | vivacy protection cing and perform mologies for the ns. Continue to d rns for discovering | technologies. aance of C2 sys rapid developr evelop tools th ng relevant linl | Complete deve stems. nent and applic nat will automa kages between | elopment of enh cation of next ge te the intelligen entities. Contin | nanced eneration at extraction, nue | | | | |
| · / | MAJOR THRUST: Investigate, analyze, intelligent information systems to varying | - | U | 1 | U | of distributed | | 7.031 | 7.385 | 8.228 |
| Proje | ect 5581 | | R-1 Sho | opping List - Item | No. 13-12 of 13- | 15 | | | Exhibit R-2a (I | PE 0602702F) |
| | | | | 252 | 2 | | | | | |

| Exhibit R-2a, RDT& | E Project Justification | D/ | DATE February 2004 | | |
|---|--|-------|-----------------------|--------------|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602702F Command Control and Communications | | UMBER AND TITLE | | |
| (U) In FY 2003: Developed a dynamic and adaptable interface technomission-tailored view of the configuration and status of the current command and control (C2) process. Developed advanced interact applications and command centers. Developed techniques and applications with multiple, heterogeneous data sets. | ntly executing Air Operation Center (AOC) tive displays suitable for deployment with C2 | | | | |
| (U) In FY 2004: Continue to develop a dynamic and adaptable interf mission-tailored view of the configuration and status of the curren develop advanced interactive displays suitable for deployment wi the development of techniques and applications for visualization technologies to improve the fidelity, accuracy, and interconnection contingency plans and response strategies. | ntly executing AOC C2 process. Continue to ith C2 applications and command centers. Complete of multiple, heterogeneous data sets. Develop | | | | |
| (U) In FY 2005: Continue to develop dynamic and adaptable interface mission-tailored view of the configuration and status of the current develop advanced interactive displays suitable for deployment with development of advanced techniques and AOC-based application with multiple, heterogeneous data sets. Continue to develop tech interconnection of computer-based wargames used to prepare corr | | | | | |
| (U) (U) MAJOR THRUST: Investigate and develop technologies to secu query within a coalition environment. Note: Broken out from the emphasis on C2 in a coalition environment. | rely share information via publish, subscribe, and | 0.000 | 0.000 | 5.276 | |
| (U) In FY 2003: Not Applicable. | | | | | |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Initiate investigation and development of technolog produce customized coalition information products. Start develop availability, integrity, and survivability of information within a condevelopment of technology approaches that will rapidly incorporatinfosphere. | pment of techniques and tools that will ensure palition Joint Battlespace Infosphere (JBI). Initiate | | | | |
| (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: Investigate and d and survivable information management and distribution services million in FY 2003 Congressional Add funding for Information M | s to enable a JBI. Note: This effort includes \$3.0 Management for Crisis Response. | 6.238 | 2.671 | 2.904 | |
| (U) In FY 2003: Developed techniques for integrating legacy client-s web-enabled information management environments. Investigate | | | | | |
| Project 5581 | R-1 Shopping List - Item No. 13-13 of 13-15 | | Exhibit R-2a (l | PE 0602702F) | |

| Exhibit R-2a, RDT&E Pro | DA | DATE February 2004 | | | | | |
|---|--|---|-----------------|--------------|--|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602702F Command Control and Communications | PROJECT NUMBER AND TITLE 5581 Command and Control (C2) Technology | | | | | |
| participating C2 and intelligence, surveillance, and reconnaissance clients Investigated and developed technologies that will ensure availability, integ a Joint Battlespace Infosphere. (U) In FY 2004: Continue to develop techniques and tools for integrating lega systems into a publish, subscribe, and query infosphere. (U) In FY 2005: Complete development of techniques and tools for integrating publish-subscribe and query infosphere. Continue to investigate and development of techniques and tools for integrating | grity, and survivability of information within acy client-server command and control (C2) ng legacy client-server C2 systems into a | | | | | | |
| technologies enabling a secure infosphere that can support thousands of C reconnaissance clients, and can operate within a coalition warfighting env optimize publish, subscribe, and query mechanisms within bandwidth lim | ironment. Investigate techniques to | | | | | | |
| (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop next generation rassessment technologies and tools enabling distributed aerospace commar develop effects based campaigns. Note: This effort includes \$1.0 million Effects-Based Planning Execution Assessment. | 6.531 | 10.084 | 9.963 | | | | |
| (U) In FY 2003: Developed the next generation of planning and assessment to commanders to determine and create the desired operational effects at the Developed technologies to dynamically assess the battlespace, determine provide near-real-time command of forces to execute those measures. De success of qualitatively different courses of action. Developed intelligent joint/coalition C2 systems for various missions. Developed and assessed dynamic mobile C2 applications. Developed tools to increase situational push and pull in dynamic environments. | right place and at the right time. measures to create the desired effects, and veloped tools to visualize the probability of agent technologies capable of supporting active template technologies for use in | | | | | | |
| (U) In FY 2004: Develop the next generation of monitoring, planning, execut enabling aerospace commanders to efficiently and collaboratively develop develop technologies to dynamically and rapidly assess the battlespace, ar manned and unmanned forces to execute the required missions. Investiga for incorporation into command and control (C2) tools. Continue to devel success of qualitatively different courses of action. Continue to develop in supporting joint/coalition C2 for various missions. Develop and assess ac technologies for use in mobile C2 applications. Continue to develop tools intelligent information push and pull in dynamic environments. | b effects-based campaigns. Continue to nd provide near-real-time command of te developments in decision support science lop tools to visualize the probability of ntelligent information systems capable of tive template and semantic ontology | | | | | | |
| (U) In FY 2005: Continue to develop technologies to dynamically and rapidly near-real-time command of manned and unmanned forces to execute the r | equired missions incorporating | | | | | | |
| Project 5581 R-1 Sho | pping List - Item No. 13-14 of 13-15 | | Exhibit R-2a (F | PE 0602702F) | | | |

| | | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | DATE | DATE February 2004 | | | |
|---|--|---------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|--|-----------------------------------|-------------------|--|--|
| BUDGET ACTIVITY PE NUMBER AND TITLE 02 Applied Research 0602702F Command Control and Communications | | | | | | | trol and | PROJECT NUMBER AND TITLE 5581 Command and Control (C2 Technology | | | | |
| (U) | developments in decision support science. Complete development of tools to visualize the probability of success of qualitatively different courses of action. Continue to develop intelligent information systems capable of supporting joint/coalition command and control (C2) for various missions. Continue to develop and assess active template and semantic ontology technologies for use in C2 applications. Continue to develop tools to increase situational awareness through intelligent information push and pull in dynamic environments. Initiate investigation of intelligent information processing techniques to enhance the C2 decision making process.24.7302 | | | | | | | | | | | |
| (U) | C. Other Program Funding Sum | | | | | | | | | | | |
| (U) (U) (U) | Related Activities: PE 0603617F, C3 Applications. PE 0303401F, Communications-Computer Systems (C-CS) Security RDT&E. PE 0603789F, C3I Advanced Development. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> | | |
| (U) | D. Acquisition Strategy Not Applicable. | | | | | | | | | | | |
| Pro | bject 5581 | | R | -1 Shopping List - I | tem No. 13-15 of | 13-15 | | | Exhibit R-2a | PE 0602702F) | | |

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PE NUMBER: 0602805F PE TITLE: Dual Use Science & Technology

| ACTIVITY | | | | | | | | February | 2004 |
|---|--|---|--|---|--|---|--|--|---|
| lied Research | | | | E NUMBER AND 602805F Dua | I Use Science | e & Technolo | gy | | |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| Cost (\$ III MIIIIOIIS) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| Total Program Element (PE) Cost | 10.075 | 10.496 | 5.151 | 2.961 | 5.147 | 5.317 | 5.480 | 0.000 | 0.00 |
| Dual Use Science and Technology (S&T) | 10.075 | 10.496 | 5.151 | 2.961 | 5.147 | 5.317 | 5.480 | 0.000 | 0.00 |
| his program seeks to leverage industry in bjective of this program is for the Air Fo and to promote more affordable defense s and specific Air Force programs. The con- schnologies. Specific projects are determ | nvestments with rce to stimulate ystems that main operative fundin nined through ar | the development ntain battlespace g assures joint nual competiti | ent of dual use to ce superiority. commitment to ive solicitations | technologies so A critical composite transition the transition s. Technology | as to provide g ponent of this p and dual use de areas considere | reater access to rogram is the c velopment effo d may include | o commercially ost-sharing req orts of successf advanced mate | v developed tec uirement from ully demonstra | hnologies industry ted |
| . Program Change Summary (\$ in Mil | llions) | | | | | | | | |
| unious Duraidant's Durdont | | | | | | | | | <u>FY 2005</u> |
| • | | | | | | | | | 8.864 5.151 |
| • | | | | | | | | | 5.151 |
| 5 | | | | | | -0.320 | -0 | .090 | |
| | | | | | | | -0 | 090 | |
| 6 | | | | | | | 0 | .070 | |
| 6 | | | | | | | | | |
| | | | | | | -0.320 | | | |
| | | | | | | | | | |
| | s President's Bu | dget are a resu | lt of higher Ai | Force prioritie | es. | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | R-1 St | iopping List - Iten | n No. 14-2 of 14- | 7 | | | Exhibit R-2 (I | PE 0602805E) |
| | Cost (\$ in Millions) Total Program Element (PE) Cost Dual Use Science and Technology (S&T) Mission Description and Budget Iten his program seeks to leverage industry in bjective of this program is for the Air Fo nd to promote more affordable defense s nd specific Air Force programs. The code echnologies. Specific projects are deternent ensors; advanced propulsion, power, and Program Change Summary (\$ in Mil revious President's Budget urrent PBR/President's Budget otal Adjustments ongressional Program Reductions ongressional Increases eprogrammings BIR/STTR Transfer ignificant Program Changes: | Cost (\$ in Millions)FY 2003 ActualTotal Program Element (PE) Cost10.075Dual Use Science and Technology (S&T)10.075Mission Description and Budget Item Justification his program seeks to leverage industry investments with bjective of this program is for the Air Force to stimulate nd to promote more affordable defense systems that main nd specific Air Force programs. The cooperative fundin echnologies. Specific projects are determined through ar ensors; advanced propulsion, power, and fuel efficiency;Program Change Summary (\$ in Millions)revious President's Budget orgressional Program Reductions ongressional Increases eprogrammingsBIR/STTR Transfer ignificant Program Changes: | Cost (\$ in Millions) FY 2003 Actual FY 2004 Estimate Total Program Element (PE) Cost 10.075 10.496 Dual Use Science and Technology 10.075 10.496 Mission Description and Budget Item Justification | Cost (\$ in Millions) FY 2003 Actual FY 2004 Estimate FY 2005 Estimate Total Program Element (PE) Cost 10.075 10.496 5.151 Dual Use Science and Technology 10.075 10.496 5.151 Mission Description and Budget Item Justification Mission Description and Budget Item Justification his program seeks to leverage industry investments with interests in advanced technol bjective of this program is for the Air Force to stimulate the development of dual use ind to promote more affordable defense systems that maintain battlespace superiority. ad specific Air Force programs. The cooperative funding assures joint commitment to echnologies. Specific projects are determined through annual competitive solicitations ensors; advanced propulsion, power, and fuel efficiency; information and communicat Program Change Summary (\$ in Millions) revious President's Budget urrent PBR/President's Budget otal Adjustments ongressional Increases eprogrammings BIR/STTR Transfer ignificant Program Changes: hanges to this program since the previous President's Budget are a result of higher Air | Cost (\$ in Millions) FY 2003 Actual FY 2004 Estimate FY 2005 Estimate FY 2006 Estimate Total Program Element (PE) Cost 10.075 10.496 5.151 2.961 Dual Use Science and Technology 10.075 10.496 5.151 2.961 Lual Use Science and Technology 10.075 10.496 5.151 2.961 Mission Description and Budget Item Justification 3.0175 3.0496 5.151 2.961 Mission Description and Budget Item Justification 3.0175 3.0496 5.151 2.961 Mission Description and Budget Item Justification 5.151 2.961 Mission Description and Budget Item Justification 3.0175 3.0175 3.0175 | Cost (\$ in Millions)FY 2003 ActualFY 2004 EstimateFY 2005 EstimateFY 2006 EstimateTotal Program Element (PE) Cost10.07510.4965.1512.9615.147Dual Use Science and Technology (S&T)10.07510.4965.1512.9615.147 Mission Description and Budget Item Justification his program seeks to leverage industry investments with interests in advanced technologies of mutual advantage to tbjective of this program is for the Air Force to stimulate the development of dual use technologies so as to provide gnd to promote more affordable defense systems that maintain battlespace superiority. A critical component of this pnd specific Air Force programs. The cooperative funding assures joint commitment to the transition and dual use deexchnologies. Specific projects are determined through annual competitive solicitations. Technology areas considereensors; advanced propulsion, power, and fuel efficiency; information and communications technologies; and weapor. Program Change Summary (\$ in Millions)revious President's Budgetotal Adjustmentsongressional Program Reductionsongressional IncreaseseprogrammingsBIR/STTR Transfer | Cost (\$ in Millions)FY 2003 ActualFY 2004 EstimateFY 2005 EstimateFY 2006 EstimateFY 2007 EstimateFY 2008 EstimateTotal Program Element (PE) Cost10.07510.4965.1512.9615.1475.317Dual Use Science and Technology10.07510.4965.1512.9615.1475.317Mission Description and Budget Item Justificationhis program seeks to leverage industry investments with interests in advanced technologies of mutual advantage to the Air Force a bjective of this program is for the Air Force to stimulate the development of dual use technologies so as to provide greater access to al specific Air Force programs. The cooperative funding assures joint commitment to the transition and dual use development of this program is due to development of a specific Air Force programs. The cooperative schling assures joint commitment to the transition and dual use development eff schnologies. Specific projects are determined through annual competitive solicitations. Technology areas considered may include ensors; advanced propulsion, power, and fuel efficiency; information and communications technologies; and weapon systems susta a JO.75revious President's Budget10.395urrent PBR/President's Budget10.395orgressional Rescissions ongressional Rescissions hanges to this program since the p | Cost (\$ in Millions) FY 2003 Actual FY 2004 Estimate FY 2005 Estimate FY 2007 Estimate FY 2008 Estimate Total Program Element (PE) Cost 10.075 10.496 5.151 2.961 5.147 5.317 5.480 Dual Use Science and Technology 10.075 10.496 5.151 2.961 5.147 5.317 5.480 Mission Description and Budget Item Justification Mission Description and Budget Item Justification Mission description and Budget Item Justification Mission description and Budget Item Justification Mission Description and Budget Item Justification Mission description and Budget Item Justification Mission description and Budget Item Justification Mission Description and Budget Item Justification Mission description and Budget Item Justification Mission description and Budget Item Justification Mission Description and Budget Item Justification Mission description and Budget Item Justification Mission description and Budget Item Justification Display the program State Item Justification Item Justification State Item Justification State Ite | Cost (\$ in Millions) FY 2003 Actual FY 2004 Estimate FY 2005 Estimate FY 2007 Estimate FY 2008 Estimate FY 2009 Estimate Cost to Estimate Total Program Element (PE) Cost 10.075 10.496 5.151 2.961 5.147 5.317 5.480 0.000 Use Science and Technology 10.075 10.496 5.151 2.961 5.147 5.317 5.480 0.000 Mision Description and Budget Item Justification 10.075 10.496 5.151 2.961 5.147 5.317 5.480 0.000 Mision Description and Budget Item Justification 10.075 10.496 5.151 2.961 5.147 5.317 5.480 0.000 Mision Description and Budget Item Justification 10.075 10.496 5.151 2.961 5.147 5.317 5.480 0.000 Mision Description and Budget Item Justification the development of dual use technologies so as to provide greater access to commercially developed technologies for programs is the cost-sharing requirement from ad specific Air Force programs. The cooperative funding assures joint commitment to the transition and dual use development efforts of successfully demonstra technologies fop |

| | ExI | hibit R-2a, I | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 | |
|---|---|--|--|---|--|---|---|---|---|------------------------------|--|
| | ET ACTIVITY pplied Research | | | 0 | e NUMBER AND 602805F Dua echnology | | e & | PROJECT NUMBER AND TITLE 4770 Dual Use Science and Technology (S&T) | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | |
| 4770 | (\$&T) | 10.075 | 10.496 | 5.151 | 2.961 | 5.147 | 5.317 | 5.480 | 0.000 | 0.000 | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| | This program seeks to leverage industry is objective of this program is for the Air For and to promote more affordable defenses and specific Air Force programs. The con- technologies. Specific projects are determ sensors; advanced propulsion, power, and | orce to stimulate systems that main operative fundir nined through a | the development ntain battlespa ng assures joint nnual competit | ent of dual use ce superiority. commitment to ive solicitation | technologies so A critical com o the transition s. Technology | as to provide ponent of this p and dual use do areas considered | greater access program is the evelopment ef ed may include | to commercially cost-sharing rec forts of successf e advanced mate | y developed tech quirement from fully demonstra | hnologies industry ted | |
| (U) 1 (U) 1 | B. Accomplishments/Planned Program (MAJOR THRUST: Advance materials and In FY 2003: Explored processes and techn launch systems. Technology areas of inter and adaptive skins; corrosion resistant coat space launch; and agile materials for use ir In FY 2004: Enhance the capability, perfo space systems. Technology areas of intere designed coatings; evaluation techniques; n materials for use in force protection. In FY 2005: Continue to enhance the capa commercial air and space systems. Technology resistant and genetically designed coatings space launch; and agile materials for use ir | d manufacturing nologies relative rest included: not tings; micro- an n force protectio ormance, durabil st include: sma nano-scale elect ability, perform plogy areas of in ; evaluation tect | to Air Force a on-destructive/ d nano-scale el n. ity, and afford rt and adaptive ronics; special: ance, durability nterest include: hniques; nano- | non-intrusive e ectronics; dura ability of Air F e skins; corrosic ized materials f y, and affordab smart and ada | evaluation techn ble, lightweigh force and comm on resistant and for space launch ility of Air Force uptive skins; con | hiques; smart t materials for hercial air and genetically h; and agile ce and rrosion | E | <u>¥ 2003</u> 2.015 | <u>FY 2004</u> 2.663 | <u>FY 2005</u> 1.306 | |
| (U)] | MAJOR THRUST: Design and develop as In FY 2003: Enabled affordable advanced platforms. Technology areas of interest in (i.e., infrared) detection; and high-speed, p In FY 2004: Expand the design and develo | sensors and tec cluded: timely recision tempor | hnologies tied , high quality, _j al, spatial, and | to commercial precision imagi attitude sensor | and military air ing; sensitive el s and controller | lectromagnetic rs. | | 2.015 | 1.728 | 0.848 | |
| Proje | ect 4770 | | R-1 Sł | nopping List - Iter | m No. 14-3 of 14- | 7 | | | Exhibit R-2a (F | PE 0602805F) | |

| Exhibit R-2a, RDT&E Project Justification | I | DATE February | 2004 | | |
|---|--------------|---|-------|--|--|
| BUDGET ACTIVITY PE NUMBER AND TITLE 02 Applied Research 0602805F Dual Use Science Technology | ce & 4770 Du | PROJECT NUMBER AND TITLE 4770 Dual Use Science and Technology (S&T) | | | |
| the capabilities of military and commercial air and space platforms. Technology areas of interest include real-time, high-resolution, precision imaging; sensitive ambient electromagnetic (e.g., infrared) detection; and high-speed, precision temporal, spatial, and attitude sensors and controllers. (U) In FY 2005: Continue to expand the design, efficiency, and affordability of advanced sensors and associated technologies for military and commercial air and space platforms. Technology areas of interest include real-time, high-resolution, precision imaging and tracking devices; sensitive, multi- and cross-environmental electromagnetic sensors; and high-speed, high-precision spatial and attitude sensors and multi-component controllers. | | | | | |
| (U) (U) MAJOR THRUST: Develop propulsion, power, energy, and fuel efficiencies and affordability. (U) In FY 2003: Improved the performance, increased the life, and reduced the cost of military and commercial air and space operations. Technology areas of interest included: performance and emissions of airbreathing and rocket propulsion systems; advanced gas turbine combustion and blades; electric propulsion alternatives; energy processing, storage, and conversion; lasers; and smart engine health monitoring techniques. (U) In FY 2004: Continue to enhance the operational capability, expand the life, and reduce the cost of military and | 2.015 | 2.614 | 1.283 | | |
| commercial air and space operations. Technology areas of interest include: airbreathing and rocket propulsion systems; gas turbine engines and blades; electric propulsion alternatives; energy processing, storage, and conversion; lasers; and smart engine health monitoring techniques. (U) In FY 2005: Continue to enhance the operational capability, expand the life, and reduce the cost of military and commercial air and space operations. Technology areas of interest include: engine and motor performance and emissions; turbine and hypersonic engine combustion and dynamics; power processing, storage, and conversion; and smart engine health monitoring techniques. | | | | | |
| (U) (U) MAJOR THRUST: Advance information and communication technologies. (U) In FY 2003: Enhanced the collection, processing, dissemination, security, accuracy, and presentation of information to U.S. and coalition military decision-makers and corresponding commercial industry sectors. Technology areas of interest include: collecting, synthesizing, and encoding pertinent information; securing the high-speed and reliable fusion, accuracy, security, and transmission of information; and presenting the appropriate information in an efficient timely, consistent, and easily understood manner. | 2.015 t, | 1.762 | 0.865 | | |
| (U) In FY 2004: Further enhance the collection, processing, dissemination, security, accuracy, and presentation capabilities of military and commercial information systems. Technology areas of interest include collecting, synthesizing, and encoding pertinent information; securing high-speed and reliable fusion, accuracy, security, and transmission of information; and presenting relevant information in an efficient, timely, consistent, and easily understood manner. | | | | | |
| (U) In FY 2005: Promote new technologies to collect, collate, process, distribute, recall, and secure high-accuracy dataProject 4770R-1 Shopping List - Item No. 14-4 of 14-7 | | Exhibit R-2a (| | | |

| | Exhibit R-2a, RDT&E Project Justification | | | | | | | | | |
|--|---|--|---------------------|-------------------------|--------------------|-----------------|-------------|---------------------|-----------------|--|
| BUDGET ACTIVITY 02 Applied Research | | PE NUMBER AND TITLE 0602805F Dual Use Science & Technology | | | | NUMBER AND TITL | | | | |
| on and across military and commen | - | | | | | | | | | |
| synthesizing, and encoding; proces | ssing, fusion, and | security; as well | l as timeliness, a | ccuracy, and pre | ecision. | | | | | |
| (U) (U) MAJOR THRUST: Enhance wear | on systems susta | inment to prolo | ng system life an | d reduce life-cv | cle costs | | 2.015 | 1.729 | 0.849 | |
| (U) In FY 2003: Extended the life and | | - | | | | | 2.010 | 1., 29 | 0.017 | |
| Force and commercial air and spac | | | | • | • | | | | | |
| fracture; corrosion; cost-effective t | echniques for not | n-invasive, real- | time monitoring | of system health | n/performance; | | | | | |
| and associated environmental impa | | | | | | | | | | |
| (U) In FY 2004: Prolong and enhance | - | - | • | • | - | 1. | | | | |
| life of both Air Force and commerce fatigue and fracture; corrosion; cos | - | | | | | 15 | | | | |
| health/performance; and associated | | • | asive, rear-time | monitoring of s | ystem | | | | | |
| (U) In FY 2005: Enhance sustainabilit | | - | erability, efficier | ncy, and affordat | bility of military | , | | | | |
| and commercial air and space prop | ulsion. Technolo | ogy areas of inter | rest include mate | erials fatigue, fra | icture, and | | | | | |
| corrosion; real-time health monitor | ring; as well as av | vionics, electroni | cs, and associate | ed technologies. | | | | | | |
| (U) Total Cost | | | | | | | 10.075 | 10.496 | 5.151 | |
| (U) <u>C. Other Program Funding Sum</u> | <u>ımary (\$ in Milli</u> | ons) | | | | | | | | |
| | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2</u> | | I otal Cost | |
| | <u>Actual</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Esti</u> | nate <u>Complet</u> | e | |
| U) Related Activities: PE 0601102F, Defense Research | | | | | | | | | | |
| (U) Sciences. | | | | | | | | | | |
| (U) PE 0602102F, Materials. | | | | | | | | | | |
| (U) PE 0602201F, Aerospace Flight | | | | | | | | | | |
| Dynamics. | | | | | | | | | | |
| (U) PE 0602202F, Human | | | | | | | | | | |
| Effectiveness. PE 0602203F, Aerospace | | | | | | | | | | |
| (U) Propulsion. | | | | | | | | | | |
| PE 0602204F Aerospace | | | | | | | | | | |
| (U) Sensors. | | | | | | | | | | |
| (U) PE 0602500F, | | | | | | | | | | |
| Multi-Disciplinary Space | | | | | | | | | | |
| Project 4770 | | F | R-1 Shopping List | Harris N. L. A. A. F C. | 4 4 7 | | | | a (PE 0602805F) | |

| Exhibit R-2a, RDT&E Project Justification | | | | | | | | |
|---|---|---|--|--|--|--|--|--|
| | PE NUMBER AND TITLE | February 2004 PROJECT NUMBER AND TITLE | | | | | | |
| BUDGET ACTIVITY 02 Applied Research | 0602805F Dual Use Science & Technology | 4770 Dual Use Science and Technology (S&T) | | | | | | |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | | | | | | | |
| (U) Technology. PE 0602601F, Space Technology. | | | | | | | | |
| (U) PE 0602602F, Conventional Munitions. | | | | | | | | |
| (U) PE 0602605F, Directed Energy Technology. | | | | | | | | |
| U) PE 0602702F, Command Control and Communications. PE 0603112F, Advanced | | | | | | | | |
| U) Materials for Weapon Systems. PE 0603203F, Advanced | | | | | | | | |
| Aerospace Sensors. PE 0603211E Aerospace | | | | | | | | |
| U) Structures. PE 0603216F, Aerospace | | | | | | | | |
| U) Propulsion and Power Technology. | | | | | | | | |
| PE 0603231F, Crew Systems U) and Personnel Protection | | | | | | | | |
| Technology. PE 0603270F, Electronic Combat Technology. | | | | | | | | |
| U) PE 0603401F, Advanced Spacecraft Technology. | | | | | | | | |
| PE 0603500F, Multi-Disciplinary Advanced Development Space | | | | | | | | |
| Technology. PE 0603601F, Conventional | | | | | | | | |
| Weapons Technology.U) PE 0603605F, Advanced | | | | | | | | |
| Project 4770 R- | 1 Shopping List - Item No. 14-6 of 14-7 | Exhibit R-2a (PE 0602805F) | | | | | | |

| Exhibit R-2a, RDT&E | Project Justification | DATE February 2004 | | |
|---|---|-------------------------|--|--|
| BUDGET ACTIVITY 2 Applied Research | | | | |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Weapons Technology. PE 0603789F, C3I Advanced Development. This program has been coordinated through the U) Reliance process to harmonize efforts and eliminate duplication. | | Technology (S&T) | | |
| U) D. Acquisition Strategy Not Applicable. | | | | |
| Project 4770 | R-1 Shopping List - Item No. 14-7 of 14-7 | Exhibit R-2a (PE 060280 | | |

PE NUMBER: 0602890F PE TITLE: High Energy Laser Research

| | bit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 |
|--|---|---|--|--|---|---|--|--|--|
| BUDGET ACTIVITY D2 Applied Research | | | | E NUMBER AND 602890F Higl | TITLE | er Research | | 1 obruary : | 2004 |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| Total Program Element (PE) Cost5096High Energy Laser Research | 0.000 | 41.498 41.498 | 45.333 45.333 | 48.316 48.316 | 51.699 51.699 | 52.143 52.143 | 53.053 53.053 | Continuing Continuing | TB TB |
| In FY 2004, this program was transferrender the High Energy Laser (HEL) Joint Tech A. Mission Description and Budget Ite This program funds DOD HEL applied reprecision, significant magazine depth, low missions including interception of ballist of targets in urban environments with no under this program are chosen for their programs that are directed at more specific control, optics, propagation, and free elect This program is in Budget Activity 2, Applied to the specific control of the specific control optics. | mology Office (J m Justification esearch through w-cost per kill, a ic missiles in boo collateral damag otential to have n ic Service needs ctron lasers. | TO). the HEL JTO. nd reduced log ost phase; defea ge. This progra najor impact o . A broad rang | HEL weapon s istics requirem at of high-speed im is part of an n multiple HEI e of technologi | systems have m ents. As a resu d, maneuvering overall DOD F systems and c es are addresse | any potential ad lt, HELs have t g anti-ship and a HEL Science an on multiple Serv ed in key areas s | lvantages, inclu he potential to p nti-aircraft mis d Technology p ice missions w uch as chemica | iding speed-of perform a wide siles; and the u program. In ge hile compleme il lasers, solid- | E-light velocity, e variety of mili ultra-precision r eneral, efforts fu enting Service/A state lasers, bea | high itary negation unded Agency |
| technologies | | | | | , | i illinitar y adinty | | ry and revolution | onary |
| technologies. U) <u>B. Program Change Summary (\$ in M</u> | <u>illions)</u> | | | | · | | | | · |
| U) <u>B. Program Change Summary (\$ in M</u> | <u>illions)</u> | | | | · | FY 2003 | <u>FY 2</u> | 2004 | <u>FY 2005</u> |
| U) <u>B. Program Change Summary (\$ in M</u> U) Previous President's Budget | <u>illions)</u> | | | | · | <u>FY 2003</u> 0.000 | <u>FY 2</u> 41 | <u>2004</u> .854 | <u>FY 2005</u> 45.452 |
| U) <u>B. Program Change Summary (\$ in M</u> U) Previous President's Budget U) Current PBR/President's Budget | <u>illions)</u> | | | | · | <u>FY 2003</u> 0.000 0.000 | <u>FY 2</u> 41 41 | <u>2004</u> .854 .498 | <u>FY 2005</u> |
| U) <u>B. Program Change Summary (\$ in M</u> U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments | <u>illions)</u> | | | | · | <u>FY 2003</u> 0.000 | <u>FY 7</u> 41 41 -0 | <u>2004</u> .854 | <u>FY 2005</u> 45.452 |
| U) B. Program Change Summary (\$ in M U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments U) Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings | | by the Office | of the Secretar | y of Defense. 7 | | <u>FY 2003</u> 0.000 0.000 0.000 | <u>FY</u> 41 41 -0 -0 | 2 <u>004</u> .854 .498 .356 | <u>FY 2005</u> 45.452 45.333 |

| Cost (s in Millions)ActualEstimateEstimateEstimateEstimateEstimateEstimateEstimateComplete3096High Energy Laser Research0.000 41.498 45.333 48.316 51.699 52.143 53.053 ContinuingQuantity of RDT&E Articles000000000(I)A.Mission Description and Budget Item JustificationThis program funds DOD HEL applied research through the HEL JTO. HEL weapon systems have many potential advantages. including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HEL shave the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and the ultra-precision negation of argoiram is part of an overall DOD HEL spite. Science and Technology program. Is part of an overall DOD HEL Science and Technology program. Is part of an overall DOD HEL Science and Technology program. Is funded under this program are chosen for their potential to have major impact on multiple HEL systems and on multiple Service missions while complementing Service/Agency program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.(I) BAccomplishments/Planned Program (S in Millions) EY 2003 EY 2004 EY 201(I) FY 2003, this activity was performed under PE 0602890D8Z, High Energy Laser Research, and the approximate funding for FY 2003 was \$45.9 million.11.00011(I) BACcomplish | | ExI | hibit R-2a, F | RDT&E Pro | ject Justifi | ication | | | DATE | February | 2004 |
|---|--------------------------|---|---|--|--|--|--|--|--|---|--|
| Cost (s in Millions) Actual Estimate Estimate <thin astimate<="" th=""> Estimate<</thin> | | | | 0602890F High Energy Lase | | | | | | | |
| Actual Estimate < | | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| Quantity of RDT&E Articles 0 </td <td></td> <td>Cost (\$ III MIIIIOIIS)</td> <td>Actual</td> <td>Estimate</td> <td>Estimate</td> <td>Estimate</td> <td>Estimate</td> <td>Estimate</td> <td>Estimate</td> <td>Complete</td> <td></td> | | Cost (\$ III MIIIIOIIS) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| (U) A.Mission Description and Budget Item Justification This program funds DOD HEL applied research through the HEL JTO. HEL weapon systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-aircraft missiles; and the ultra-precision negatio of targets in urban environments with no collateral damage. This program is part of an overall DOD HEL Science and Technology program. In general, efforts funded under this program are chosen for their potential to have major impact on multiple HEL systems and on multiple Service missions while complementing Service/Agency, programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid-state lasers, beam control, optics, propagation, and free electron lasers. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies. (U) <u>B.Accomplishments/Planned Program (\$ in Millions)</u> FY 2003 FY 2004 FY: (U) For FY 2003 was \$45.9 million. (U) MAJOR THRUST: Explore solid state lasers that have potential for the quickest impact in future HEL weapons 0.000 11.000 11 because of their inherent small size and the fact that they require only electrical energy in order to run, thereby greatly simplifying systems engineering and supportability. (I) In FY 2003: Not Applicable. (I) In FY 2004: Continue dovelop enabling solid state laser technologies through applied research necessary for the demonstration of solid state lasers at initial weapon grade power le | 5090 | 0 0; | 0.000 | 41.498 | 45.333 | 48.316 | 51.699 | 52.143 | 53.053 | 3 Continuing | TBD |
| This program funds DOD HEL applied research through the HEL JTO. HEL weapon systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missies in boost phase; defeat of high-speed, manewering anti-ship and anti-aircraft missiles; and the ultra-precision negatio of targets in urban environments with no collateral damage. This program is part of an overall DOD HEL Science and Technology program. In general, efforts funded under this program are chosen for their potential to have major impact on multiple HEL systems and on multiple Service missions while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid-state lasers, beam control, optics, propagation, and free electron lasers. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies. (U) B. Accomplishments/Planned Program (S in Millions) FY 2003 FY 2004 FY 201 (U) For FY 2003, this activity was performed under PE 0602890D8Z, High Energy Laser Research, and the approximate funding for FY 2003 was \$45.9 million. 0.000 11.000 11 (U) In FY 2003, this activity as performed under PE 0602890D8Z, High Energy in order to run, thereby greatly simplifying systems engineering and supportability. (U) In FY 2003, this actilasers that have potential for the quickest i | | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 |) | |
| (U) For FY 2003, this activity was performed under PE 0602890D8Z, High Energy Laser Research, and the approximate funding for FY 2003 was \$45.9 million. (U) (U) MAJOR THRUST: Explore solid state lasers that have potential for the quickest impact in future HEL weapons (U) MAJOR THRUST: Explore solid state lasers that have potential for the quickest impact in future HEL weapons (U) MAJOR THRUST: Continue to the fact that they require only electrical energy in order to run, thereby greatly simplifying systems engineering and supportability. (U) In FY 2003: Not Applicable. (U) In FY 2004: Continue to develop enabling solid state laser technologies through applied research necessary for the demonstration of solid state lasers at initial weapon grade power levels. Under the Joint High Power Solid State Laser program continue development of solid state laser technologies through applied research necessary for the demonstration of solid state laser at laser designs. (U) In FY 2005: Continue to mature enabling solid state laser technologies through applied research necessary for the demonstration of solid state lasers at initial weapon grade power levels. Support the Joint High Power Solid State Laser program demonstration of 25 kilowatts devices leading to follow-on 100 kilowatt solid state laser designs. (U) In FY 2005: Continue to mature enabling solid state laser technologies through applied research necessary for the demonstration of 25 kilowatts devices leading to follow-on 100 kilowatt solid state laser designs. (U) In FY 2005: Continue to mature enabling solid state laser technologies through applied research necessary for the demonstration of 25 kilowatts devices leading to follow-on 100 kilowatt solid state laser designs. (U) | (U) | This program funds DOD HEL applied re precision, significant magazine depth, low missions including interception of ballisti of targets in urban environments with no under this program are chosen for their po programs that are directed at more specifi control, optics, propagation, and free elec This program is in Budget Activity 2, App | esearch through v-cost per kill, a c missiles in bo collateral damag otential to have to c Service needs tron lasers. | nd reduced log ost phase; defe ge. This progra major impact o . A broad rang | tistics requirem at of high-spee am is part of an on multiple HEI ge of technologi | d, maneuvering overall DOD F systems and c ies are addresse | It, HELs have to ganti-ship and a HEL Science ar on multiple Ser- ed in key areas | the potential to anti-aircraft m ad Technology vice missions such as chemi | p perform a wid issiles; and the program. In g while complen cal lasers, solid | de variety of mil ultra-precision general, efforts f nenting Service/. l-state lasers, be | itary negation unded Agency am |
| (U) MAJOR THRUST: Explore solid state lasers that have potential for the quickest impact in future HEL weapons (D) 0.000 11.000 11 because of their inherent small size and the fact that they require only electrical energy in order to run, thereby greatly simplifying systems engineering and supportability. (U) In FY 2003: Not Applicable. (U) In FY 2004: Continue to develop enabling solid state laser technologies through applied research necessary for the demonstration of solid state laser at initial weapon grade power levels. Under the Joint High Power Solid State Laser program continue development of solid state laser designs. (U) In FY 2005: Continue to mature enabling solid state laser technologies through applied research necessary for the demonstration of solid state lasers at initial weapon grade power levels. Support the Joint High Power Solid State Laser for the demonstration of solid state lasers at initial weapon grade power levels. Support the Joint High Power Solid State Laser for the demonstration of solid state lasers at initial weapon grade power levels. Support the Joint High Power Solid State Laser for the demonstration of 25 kilowatts devices leading to follow-on 100 kilowatt solid state laser designs. (U) | (U) | For FY 2003, this activity was performed u | | 90D8Z, High E | Energy Laser Ro | esearch, and the | e approximate | <u>FY</u> | <u>7 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| | (U) (U) (U) (U) | because of their inherent small size and the simplifying systems engineering and support In FY 2003: Not Applicable. In FY 2004: Continue to develop enabling demonstration of solid state lasers at initial program continue development of solid stat 2005 and follow-on 100 kilowatt solid stat In FY 2005: Continue to mature enabling demonstration of solid state lasers at initial Laser program demonstration of 25 kilowat MAJOR THRUST: Explore free electron | e fact that they r prtability. solid state lase weapon grade te laser technolo e laser designs. solid state laser weapon grade tts devices lead lasers that have | equire only ele r technologies power levels. T ogies supportin technologies tl power levels. ing to follow-o potential in fut | through applied Under the Joint ag the demonstr hrough applied Support the Join 100 kilowatt ture HEL weap | n order to run, d research neces High Power So ration of 25 kilo research necess int High Power solid state laser ons because the | thereby greatly ssary for the olid State Laser owatts in FY sary for the Solid State r designs. ey require only | | 0.000 | 8.400 | 8.400 |
| electrical energy in order to run and can be designed to operate at a the best wavelength for a specific application | | electrical energy in order to run and can be | e designed to op | erate at a the be | est wavelength | for a specific a | pplication | | | | |
| Project 5096 R-1 Shopping List - Item No. 15-2 of 15-6 Exhibit R-2a (PE 0602 264 264 | Pro | ject 5096 | | R-1 Sł | | | 6 | | | Exhibit R-2a (| PE 0602890F) |

| Exhibit R-2a, RDT& | DA | DATE February 2004 | | |
|--|---|-------------------------|----------------|--------|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602890F High Energy Laser Research | PROJECT NI 5096 High | | |
| within a large range of wavelengths. | | | | |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Continue to accelerate the scaling of free electron las power scaling milestone will be 10 kilowatts for a laboratory demote to design advanced robust long-life photocathodes. Design and be cavity at 700 megahertz for integration into 10 kilowatt demonstrate determine if new optical coating finishing methods produce optical determine if new optical coating finishing methods produce optical determine if new optical coating finishing methods produce optical determine if new optical coating finishing methods produce optical determine if new optical coating finishing methods produce optical determine if new optical coating finishing methods produce optical determine if new optical coating finishing methods produce optical determine if new optical coating finishing methods produce optical determine if new optical coating finishing methods produce optical determine if new optical coating finishing methods produce optical determine if new optical coating finishing methods produce optical determine if new optical coating finishing methods produce optical determine if new optical coating finishing methods produce optical determine if new optical coating finishing methods produce optical determine if new optical determine if new optical determine if new optical determine if new optical determine determine if new optical determine determin | onstrator. Develop a photocathode model as a tool egin fabrication of a high current radio frequency ttor. Conduct a study and begin laboratory tests to | | | |
| laser applications.(U) In FY 2005: Continue to accelerate the scaling of free electron las kilowatt laboratory demonstration to define development path for s and eventual megawatt class free electron laser. | | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop advanced solid state laser technologi devices. | ies that are applicable to future HEL weapon laser | 0.000 | 3.750 | 5.000 |
| (U) In FY 2003: Not Applicable. | | | | |
| (U) FY 2004: Develop solid state laser technologies such as laser mate cross-section and the ability to operate at high temperatures, laser a modular and scalable architectures for laser power scaling includin ceramic laser gain media materials. Optimize ceramic material ma characterize materials, and set the stage for comparison of single c performance. Develop and demonstrate a more efficient high brigh with a fiber laser system. Develop and demonstrate fiber laser bea sensing approaches. Develop and demonstrate a heat exchanger be management/storage system for solid state lasers. | gain media thermal management techniques, and ng technologies for beam combining. Develop anufacturing processes for laser applications, fully crystal material to ceramic material laser htness diode array and use it in a demonstration am combining through spectral and phase front uilding block for phase change thermal | | | |
| (U) FY 2005: Continue to develop solid state laser technologies to pro- and cross-section and the ability to operate at high temperatures, la and modular and scalable architectures for laser power scaling incl | aser gain media thermal management techniques, | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop beam-control technologies that are diareas. Results of these activities will be transitioned to near-term I HEL-related technology base and industrial capability. Develop at techniques aimed at making precise absorption measurements in in assimilating information on turbulence at locations relevant to tact real-time characterization tools to assist the HEL operator. | HEL systems and will also serve to enhance the tmospheric characterization technologies and nteresting atmospheric windows, measuring and | 0.000 | 10.218 | 10.683 |
| Project 5096 | R-1 Shopping List - Item No. 15-3 of 15-6 | | Exhibit R-2a (| |

| Exhibit R-2a, RDT&E Project | Exhibit R-2a, RDT&E Project Justification | | | | | | |
|--|---|---|-----------------|--------------|--|--|--|
| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602890F High Energy Laser Research | PROJECT NUMBER AND TITLE 5096 High Energy Laser Resear | | | | | |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Continue to develop beam control technology to improve HEL sy critical technology options for use in tactical scenarios on tactical platforms su maritime platforms, thus enabling the advantages of HELs to be applied in a w Develop high mechanical strength, high hardness HEL windows with low opti applications. Develop technology to fabricate conformal HEL windows for ta sensors that are insensitive to high scintillation environments and prepare to be high scintillation environment. Establish a government optical metrology capa and reflectivity of optical coatings. Develop methods for discrimination, point three-dimensional imaging. Continue to develop characterizations that concern | ich as aircraft, ground vehicles, and vide variety of military operations. ical path distortions for tactical HEL actical air vehicles. Develop wavefront enchmark performance in a simulated ability to precisely measure adsorption ting, and tracking in high clutter using ntrate on understanding atmospheric | | | | | | |
| limitations in low-altitude tactical scenarios in order to increase the lethal rang (U) In FY 2005: Continue to develop beam control technology to improve HEL sy critical technology options for use in tactical scenarios on tactical platforms su maritime platforms, thus enabling the advantages of HELs to be applied in a w Provide developed beam component technologies for integration into laborator comparison and enhancement. Continue to develop characterizations that conclimitations in low-altitude tactical scenarios (such as turbulence, thermal bloor order to increase the lethal range. Begin to plan a thermal blooming experime | ystem performance. Seek to provide ach as aircraft, ground vehicles, and vide variety of military operations. ry test beds for performance centrate on understanding atmospheric ming, and platform disturbances) in | | | | | | |
| (U)(U) MAJOR THRUST: Develop chemical laser technologies that provide higher p | performance and better supportability. | 0.000 | 2.750 | 3.650 | | | |
| Results of these activities will result in chemical lasers that are lighter and more (U) In FY 2003: Not Applicable. (U) In FY 2004: Continue to develop and demonstrate closed-cycle chemical laser laser-derived devices, appropriate for space-based and tactical applications. D | rs, especially chemical oxygen iodine Develop chemical laser generators that | | | | | | |
| are capable of operating in a gravity free environment and conduct proof-of-co (U) In FY 2005: Continue to develop and demonstrate closed-cycle chemical laser laser-derived devices. Conduct technology development/experiments to allow chemical laser generators and chemical regeneration techniques that can be sca applications. | rs, especially chemical oxygen iodine v selection of the most promising | | | | | | |
| (U) (U) MAJOR THRUST: Develop lethality technologies that concentrate on provide understanding of laser kill mechanisms to allow the design of future HEL syste for the minimum system size and cost. | • • • | 0.000 | 4.280 | 4.400 | | | |
| (U) In FY 2003: Not Applicable. | ng List - Item No. 15-4 of 15-6 | | Exhibit R-2a (I | PE 0602890F) | | | |

| | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | DATE February 2004 | | | |
|---|--|--|--|--|---|---------------------|-----------------------------------|-----------------------------------|-------------------|--|
| BUDGET ACTIVITY 02 Applied Research | | 0602890F High Energy Laser | | | PROJECT NUMBER AND TITLE 5096 High Energy Laser Resear | | | | | |
| (U) In FY 2004: Continue to develop between HEL beams and the targe community and validated models tactical laser weapons like the Adv (U) L EV 2005. Continue to be adv | ets they strike. Con that will be available vanced Tactical La | ntinue to develo ole to systems de aser and Mobile | p databases that esigners. Develo Tactical High E | will be accepted op a subset of tan nergy Laser. | l by the HEL rget folders for | | | | | |
| (U) In FY 2005: Continue to develop between HEL beams and the targe community and validated models | ets they strike. Con | ntinue to develo | p databases that | | | I | | | | |
| (U) (U) MAJOR THRUST: Develop a ful the laser to their death at the target expensive field testing. | 0.000 | 1.100 | 2.200 | | | | | | | |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Continue to develop models into an end-to-end engager for expensive field testing. Contin supporting many HEL systems, tar parametrically represented probab analyses. | ment model, there nue to develop wid rgets, and scenaric | by improving th lely accepted en os. The model w | e design of HEL gagement model /ill include platfo | systems and red for non-expert form constraints, | ducing the need users capable of provide | | | | | |
| (U) In FY 2005: Begin validation of i into an end-to-end engagement mo expensive field testing. Begin to v | odel, thereby impre | oving the design | of HEL system | s and reducing t | - | S | | | | |
| (U) Total Cost | vandate engageme | int model using (| service specific | seenarios. | | | 0.000 | 41.498 | 45.333 | |
| (U) <u>C. Other Program Funding Sun</u> | <u>nmary (\$ in Milli</u> | <u>ons)</u> | | | | | | | | |
| PE 0602500F, | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> Estimate | FY 2005 Estimate | <u>FY 2006</u> <u>Estimate</u> | FY 2007 Estimate | FY 2008 Estimate | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> | |
| (U) Multi-Disciplinary Space Technology. | | | | | | | | | | |
| (U) PE 0601108F, High Energy Laser Research Initiatives. | | | | | | | | | | |
| (U) PE 0603444F, Maui Space Surveillance System. (U) PE 0603500F, | | | | | | | | | | |
| (0) PE 0005300F, | | | | | | | | | | |

| Exhibit R-2a, RD | Exhibit R-2a, RDT&E Project Justification | | | | | | | | |
|--|---|--|--|--|--|--|--|--|--|
| BUDGET ACTIVITY D2 Applied Research | | | | | | | | | |
| C. Other Program Funding Summary (\$ in Millions) Multi-Disciplinary Advanced Development Space Technology. PE 0603605F, Advanced Weapons Technology. PE 0603924F, High Energy Laser Advanced Technology Program. PE 0603883C, Ballistic Missile Defense Boost Phase Segment. PE 0602605F, Directed Energy Technology. PE 0602307A, Advanced Weapons Technology. PE 0602114N, Power Projection Applied Research. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. D. Acquisition Strategy | | | | | | | | | |
| Not Applicable. | | | | | | | | | |

PE NUMBER: 0207423F PE TITLE: Advanced Communications Systems

| | Exhib | oit R-2, RDT | F&E Budge | t Item Just | ification | | | DATE | February | 2004 |
|--|--|---|--|--|---|---|---|--|---|--------------------------|
| BUDGET ACTIVITY 3 Advanced Technolog | y Development (| ATD) | | | E NUMBER AND 207423F Adv | TITLE | nunications S | Systems | rebiualy | 2004 |
| Cost (\$ in | Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| Tatal Dragman Ela | neart (DE) Ceat | Actual 0.000 | Estimate 11.951 | Estimate 13.917 | Estimate | Estimate | Estimate 0.000 | Estimate | Complete | TBI |
| Total Program Eler 5084 AJCN | nent (PE) Cost | 0.000 | 11.931 | 13.917 | 0.969 0.969 | 0.969 | 0.000 | 0.000 | Continuing Continuing | TB |
| The Adaptive Joint Co Demonstration (ACTE Commercial-Off-The- interopreable commun Needs Statements (MN intelligence and Inform | b) is developing sof Shelf (COTS) base ications, electronic IS), Operational Re | tware programm of system that ca warfare (EW), equirements Doo | nable Radio Fr an be remotely signals intellig | equency (RF) p programmed o ence (SIGINT). | ayloads design n the fly to perf , and computer | ed to support In form a variety on network operat | nformation Sup of functions similarity of functions (CNO). | eriority. AJCN nultaneously: a AJCN addresse | N is an open, ir-to-air assured s numerous Mi | l ssion |
| This program is in Buc (U) <u>B. Program Change S</u> | • | | ogy Developm | ent, since it dev | velops and dem | | - | | | |
| U) Previous President's B | ıdget | | | | | | <u>FY 2003</u> 0.000 | | <u>2004</u> 053 | <u>FY 2005</u> 13.917 |
| U) Current PBR/President | - | | | | | | 0.000 | | .951 | 13.917 |
| U) Total Adjustments | C | | | | | | 0.000 | -0 | .102 | |
| Congressional Program Congressional Rescissi Congressional Increase Reprogrammings SBIR/STTR Transfer | ons 28 | | | | | | | -0 | .102 | |
| U) <u>Significant Program C</u> None. | <u>nanges:</u> | | | | | | | | | |
| | | | | | | | | | | |

| Ext | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|---|--|--|---|---|---|---|---|---|--------------------------|
| BUDGET ACTIVITY 03 Advanced Technology Development (| (ATD) | | 0 | PE NUMBER AND 0207423F Adv Systems | BER AND TITLE | | | | |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 5084 AJCN | 0.000 | 11.951 | 13.917 | | 0.969 | 0.000 | 0.000 | Continuing | TBD |
| Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | <u> </u> |
| The Adaptive Joint Command, Control, C Demonstration (ACTD) is developing sof Commercial-Off-The-Shelf (COTS) base interopreable communications, electronic Needs Statements (MNS), Operational Re intelligence and Information Operations (| ftware programmed system that can warfare (EW), equirements Door (IO). | mable Radio Fr an be remotely signals intellig cuments (ORD | requency (RF) p programmed o gence (SIGINT)), and the Com | payloads design on the fly to per), and computer nbatant Comman | ned to support In form a variety o network operat nders Integrated | nformation Sup of functions sin tions (CNO). <i>A</i> d Priority Lists | periority. AJCl nultaneously: a AJCN addresse (IPL) related to | N is an open, air-to-air assured es numerous Mi o communicatio | d ssion ons, |
| This program is in Budget Activity 3, Adv | | ogy Developm | ent, since it de | velops and dem | ionstrates techn | • | | | |
| (U) <u>B. Accomplishments/Planned Program (</u> (U) System Engineering and Integration (U) Distribute A distribute | | | | | | <u>FY</u> | 2003 | <u>FY 2004</u> 11.272 | <u>FY 2005</u> 12.500 |
| (U) Field Evaluation/Military Utitlity Assessm(U) Concept of Operations (CONOPS)/TTP Detection (CONOPS) | | Tast | | | | | | 0.586 0.093 | 0.844 0.573 |
| (U) Total Cost | evelopment and | 1681 | | | | | 0.000 | 11.951 | 13.917 |
| | | | | | | | 0.000 | 11.701 | 15.717 |
| | <u>7 2003 FY</u> | | <u>FY 2005</u> Estimate | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | Total Cost |
| (U) Army(U) DARPA | | | | | | | | - | |
| (U) D. Acquisition Strategy All major contracts within this Program E | lement and prog | grams were aw | arded after full | l and open com | petition. | | | | |
| Project 5084 | | R-1 SI | honning List - Ite | m No. 35-2 of 35- | 2 | | | Exhibit R-2a (| PF 0207423F) |

PE NUMBER: 0401840F PE TITLE: AMC COMMAND & CONTROL SYSTEM

| Exhibit R-2, RDT&E Budget Item Justification | | | | | | | | | 2004 |
|---|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-------|
| BUDGET ACTIVITY PE NUMBER AND TITLE D3 Advanced Technology Development (ATD) 0401840F AMC COMMAND & CONTROL SYSTEM | | | | | | | | | |
| Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| Total Program Element (PE) Cost | 0.000 | 5.995 | 6.038 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5119 Agile Transportation 2001 | 0.000 | 5.995 | 6.038 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

In FY04, this is a new PE.

(U) A. Mission Description and Budget Item Justification

Agile Transportation for the 21st Century (AT21) Advanced Concept Technology Development (ACTD) provides for a suite of decision support tools capitalizing on emerging technology to enhance command and control of the Defense Transportation System (DTS). In concert with Joint Vision 2020, AT21 will focus on identifying, exploring, and fostering advanced synergistic technologies for transportation and sustainment processes with an 'end-to-end' systems perspective. AT21 will transition both COTS and GOTS maturing database, optimization and collaboration technologies into the Defense Transportation System (DTS) to improve peacetime and wartine transportation operations for all Combatant Commanders, Services, and governmental entities. Transportation mode determination and optimization for strategic lift will be based on objective, time-sensitive delivery criteria. The United States Transportation Command (USTRANSCOM) will have the ability to provide the supported CINC with modal alternatives to meet such deployment requirements as required delivery date in theater. Assignment to sealift of collaboratively selected, sealift-qualified, movement requirements will automatically increase availability of scarce airlift assets for assignment to true mission critical requirements. AT21 will produce a software toolsuite for synchronizing and optimizing all DTS operations through unit level execution. This effort will produce an immediate return on investment through better lift aggregation, cost avoidance by increased lift optimization and quality of life of the service members, due to better scheduling. Additionally, this effort will support the Combatant Commanders with improved, rapid, and collaborative transportation planning to support any force deployment.

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates cost-effective technologies to improve the design, performance, and support of current and future weapon systems.

(U) **<u>B. Program Change Summary (\$ in Millions)</u>**

| | | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
|-----|----------------------------------|----------------|----------------|----------------|
| (U) | Previous President's Budget | 0.000 | 6.046 | 6.054 |
| (U) | Current PBR/President's Budget | 0.000 | 5.995 | 6.038 |
| (U) | Total Adjustments | 0.000 | -0.051 | |
| (U) | Congressional Program Reductions | | -0.051 | |
| | Congressional Rescissions | | | |
| | Congressional Increases | | | |
| | Reprogrammings | | | |
| | SBIR/STTR Transfer | | | |
| (U) | Significant Program Changes: | | | |
| | Reduction IAW PBD 604. | | | |
| | | | | |

R-1 Shopping List - Item No. 36-1 of 36-3

| | Ex | hibit R-2a, F | RDT&E Pro | ication | | | DATE | February | 2004 | | |
|---|---------------------------------------|-----------------|-----------|----------|----------|----------|----------|----------|---|-------|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | | | | | | | | | ROJECT NUMBER AND TITLE 19 Agile Transportation 2001 | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| | Cost (\$ III WIIIIOIIS) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | |
| 5119 | Agile Transportation 2001 | 0.000 | 5.995 | 6.038 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| (U) <u>A</u> | A. Mission Description and Budget Ite | m Justification | | | | | | | | | |

Agile Transportation for the 21st Century (AT21) Advanced Concept Technology Development (ACTD) provides for a suite of decision support tools capitalizing on emerging technology to enhance command and control of the Defense Transportation System (DTS). In concert with Joint Vision 2020, AT21 will focus on identifying, exploring, and fostering advanced synergistic technologies for transportation and sustainment processes with an 'end-to-end' systems perspective. AT21 will transition both COTS and GOTS maturing database, optimization and collaboration technologies into the Defense Transportation System (DTS) to improve peacetime and wartine transportation operations for all Combatant Commanders, Services, and governmental entities. Transportation mode determination and optimization for strategic lift will be based on objective, time-sensitive delivery criteria. The United States Transportation Command (USTRANSCOM) will have the ability to provide the supported CINC with modal alternatives to meet such deployment requirements as required delivery date in theater. Assignment to sealift of collaboratively selected, sealift-qualified, movement requirements will automatically increase availability of scarce airlift assets for assignment to true mission critical requirements. AT21 will produce a software toolsuite for synchronizing and optimizing all DTS operations through unit level execution. This effort will produce an immediate return on investment through better lift aggregation, cost avoidance by increased lift optimization and quality of life of the service members, due to better scheduling. Additionally, this effort will support the Combatant Commanders with improved, rapid, and collaborative transportation planning to support any force deployment.

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates cost-effective technologies to improve the design, performance, and support of current and future weapon systems.

| (U) | B. Accomplishments/Planned Program (\$ in Millions) | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
|-----|--|----------------|----------------|----------------|
| (U) | Accomplishments/Planned Program | | | |
| (U) | Continue development of Strategic Transportation Planner (STP) to support optimization, mode determination broker and schedular. | | 1.804 | 2.025 |
| (U) | Continue development of Aircrew Scheduler, Airbase Tactical Transportation Planner, and Aircraft Maintenance Schedular to support the tactical echelon for optimization of assets. | | 1.803 | 2.028 |
| (U) | | | 0.902 | 0.980 |
| (U) | Continue development of AMC Operational Transportation Planner to support the operational echelon for optimization of assets, mode determination and schedular. | | 1.486 | 1.005 |
| (U) | Total Cost | 0.000 | 5.995 | 6.038 |
| | | | | |
| Pr | oject 5119 R-1 Shopping List - Item No. 36-2 of 36-3 | | Exhibit R-2a (| PE 0401840F) |
| | 272 | | | |

| | UNCLASSIFIED | |
|---|---|---|
| Exhibit R-2a, RDT&E P | roject Justification | DATE February 2004 |
| BUDGET ACTIVITY 3 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0401840F AMC COMMAND & CONTROL SYSTEM | PROJECT NUMBER AND TITLE 5119 Agile Transportation 2001 |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | |
| U) <u>D. Acquisition Strategy</u> | | |
| SPO plans to use sprial development, using Indefinate Delivery and In | ndefinate Quantity contracts. | |
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| | | |
| Project 5119 R-1 | Shopping List - Item No. 36-3 of 36-3 | Exhibit R-2a (PE 04018 |

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PE NUMBER: 0603112F PE TITLE: Advanced Materials for Weapon Systems

| | Exhit | bit R-2, RD | F&E Budge | t Item Just | ification | | | DATE | February | 2004 | | |
|------|---|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-------|--|--|
| | BUDGET ACTIVITY PE NUMBER AND TITLE D3 Advanced Technology Development (ATD) 0603112F Advanced Materials for Weapon Systems | | | | | | | | | | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total | | |
| | Total Program Element (PE) Cost | 39.746 | 61.948 | 34.284 | 39.814 | 46.517 | 41.390 | 42.056 | Continuing | TBD | | |
| 2100 | Laser Hardened Materials | 13.201 | 17.012 | 22.551 | 27.928 | 35.454 | 30.138 | 30.622 | Continuing | TBD | | |
| 3153 | Non-Destructive Inspection Development | 8.088 | 9.956 | 4.069 | 4.103 | 4.178 | 4.249 | 4.318 | Continuing | TBD | | |
| 3946 | Materials Transition | 14.739 | 23.876 | 5.298 | 5.397 | 4.456 | 4.533 | 4.606 | Continuing | TBD | | |
| 4918 | Deployed Air Base Demonstrations | 3.718 | 11.104 | 2.366 | 2.386 | 2.429 | 2.470 | 2.510 | Continuing | TBD | | |

Note: In FY 2003, the space unique tasks in Projects 2100 and 3946 were transferred to PE 0603500F, Project 5032, as a result of the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates materials technology for transition into Air Force systems. The program has four projects which develop: (1) laser hardened materials technologies for the broadband laser protection of aircrews and sensors; (2) non-destructive inspection and evaluation technologies; (3) transition data on structural materials for aerospace applications; and (4) airbase operations technologies including deployable base infrastructure, force protection, and fire fighting capabilities. Note: In FY 2004, Congress added \$2.1 million for Vapor Grown Carbon Fiber, \$1.4 million for Polymer Technology for Agile Combat Support, \$1.4 million for Materials Integrity Management Research (MIMR) for Air Force Systems, \$3.6 million for Quantitative Inspection Techniques for Assessing Aging of Military Aircraft, \$5.0 million for the Metals Affordability Initiative, \$1.5 million for Molecular Marking of Explosives, \$2.0 million for Hybrid Bearings, \$1.7 million for Advanced Laser Program for Plasma Enhanced Chemical Vapor Deposition, \$1.4 million for Advanced Composite Processes for Unmanned Air Vehicle (UAV) Components, \$3.0 million for E-SMART Threat Agent Network, \$3.4 million for Plasma Arc/Waste to Energy Production, \$1.1 million to Educate 21st Century Information Operations (IO) Workforce, \$1.8 million for Ceramic Matrix Composites for Engines, and \$1.0 million for Transparent Conductive Polymer Technology. Additionally, Congress reduced \$1.0 million related to the National Aerospace Initiative.

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

R-1 Shopping List - Item No. 16-2 of 16-15

Exhibit R-2 (PE 0603112F)

| | Exhibit R-2, RDT&E Bu | udget Item Justification | DATE Februa | ary 2004 | | | | | |
|-----|--|---|----------------|----------------|--|--|--|--|--|
| | BET ACTIVITY dvanced Technology Development (ATD) | PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems | | | | | | | |
| (U) | B. Program Change Summary (\$ in Millions) | | | | | | | | |
| | | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | | | | | |
| (U) | Previous President's Budget | 41.159 | 33.079 | 34.374 | | | | | |
| (U) | Current PBR/President's Budget | 39.746 | 61.948 | 34.284 | | | | | |
| (U) | Total Adjustments | -1.413 | 28.869 | | | | | | |
| (U) | Congressional Program Reductions | | -1.000 | | | | | | |
| | Congressional Rescissions | | -0.531 | | | | | | |
| | Congressional Increases | | 30.400 | | | | | | |
| | Reprogrammings | -0.386 | | | | | | | |
| | SBIR/STTR Transfer | -1.027 | | | | | | | |
| (U) | Significant Program Changes: | | | | | | | | |
| . , | Not Applicable. | | | | | | | | |

R-1 Shopping List - Item No. 16-3 of 16-15

| | Ex | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | | DATE | February | 2004 |
|---|---|---|---|--|--|---|---------------------------------|---------------------------|-----------------------|-----------------------------------|--------------------------|
| | ET ACTIVITY dvanced Technology Development | (ATD) | | C | PE NUMBER AND 0603112F Adv Weapon Syste | anced Materi | ials for | | | ER AND TITLE | erials |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 20 | 009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estim | | Complete | |
| 2100 | | 13.201 | 17.012 | 22.551 | 27.928 | 35.454 | 30.138 | | 0.622 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | |
| (U) | A. Mission Description and Budget Ite This project develops enabling materials microwave directed energy threats. Con- before, during, and after threat exposure. laser threat. Recent laser technology dev combination of approaches is required. | and concepts for cepts are demons Current protect | strated to provi- ion schemes ar | de hardening o e activated by | options for trans- intensity or way | ition to Air For velength and ar | ce systems. T e only capable | The goal is e of count | s to ensu tering a | ure mission ca specific portio | pability |
| (U) 1 9 (U) 1 (U) 1 1 (U) 1 1 (U) 1 1 1 1 1 | B. Accomplishments/Planned Program MAJOR THRUST: Develop and demonst sensors, avionics, and components to increased Increase in FY 2005 is due to an increased of FY 2003: Demonstrated complete harder for Charge Coupled Device (CCD) imagin In FY 2004: Develop hardening solutions Demonstrate image intensifier tube harder In FY 2005: Demonstrate hardening solution In FY 2005: Demonstrate hardening solution | trate advanced n ease survivability l emphasis on se ening for an elec ng systems. for replacement hing. Evaluate h ions for replacem | v and mission en nsor protection tro-optical sense sensors selecte ardening solution nent sensor selecte | effectiveness of sor system. De d for the electrons for CCD in ected for the el | f aerospace syst eveloped harden ro-optical senso maging systems | ems. Note: ing solutions r system. | <u>F</u> ` | <u>7 2003</u> 5.823 | | <u>FY 2004</u> 4.237 | <u>FY 2005</u> 12.769 |
| (U)] (U)] | MAJOR THRUST/CONGRESSIONAL A enhance laser protection for Air Force airc in a laser threat environment. Note: This of million in FY 2004 for an Advanced Laser In FY 2003: Transitioned flexible filter teo refinement. Transitioned first generation to Systems Program Office. Fabricated refin Transitioned fixed wavelength filter techn the development of tunable filter technolo- hardening technologies for use in protectin In FY 2004: Identify next generation technolo- | crews to ensure seffort includes C r Program for Pl chnology in the f tristimulus filter the tristimulus filter and tristimulus filter ology to the nigh gy for NVGs and ng eyes from agi | afety and to en ongressional A asma Enhanced form of spectac technology for atter eyewear ba at vision goggle 1 panoramic N le laser threats. | able aircrews t adds of \$1.7 m d Chemical Va des for human daytime missi used on results e (NVG) progr VGs (PNVGs) | to perform requi illion in FY 200 por Deposition. factors evaluati ions to the Life s from human fac ram for flight tes 0. Identified and | ired missions 3 and \$1.7 ons and design Support ctors study. sts. Advanced evaluated | | 7.378 | | 12.775 | 9.782 |
| Proje | ect 2100 | | R-1 Sh | opping List - Iten | m No. 16-4 of 16-1 | 5 | | | | Exhibit R-2a (F | PE 0603112F) |
| | | | | 277 | | | | | | | , , |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|-----|---|---|--|--|--|--|-----------------------------------|---|---------------------|-------------------|
| | UDGET ACTIVITY 3 Advanced Technology Development (ATD) | | | | | ND TITLE dvanced Mate stems | erials for | PROJECT NUMBER AND TITLE 2100 Laser Hardened Materials | | |
| . , | technology. Transition in-band interepresentative PNVG prototype syst. In FY 2005: Transition candidate m technology. Demonstrate night vist. performance of brassboard panoran develop optical limiter technologies. Total Cost | tem. Develop op naterials technolo ion goggle (NVG nic NVG (PNVG | tical limiter dev gy advancemen) compatible pe)/NVG systems | vices to protect e ts to improve pe ripheral protecti utilizing tunable | yes from agile la rformance of tris on eyewear. Ch | aser threats. stimulus filter aracterize the | | 13.201 | 17.012 | 22.551 |
| | | († • • • • • • • • • • • • • • • • • • • | [×] | | | | | 15.201 | 17.012 | 22.551 |
| (U) | <u>C. Other Program Funding Sum</u> | <u>mary (\$ in Millie</u> <u>FY 2003</u> Actual | o ns) <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> Estimate | <u>FY 2006</u> Estimate | <u>FY 2007</u> Estimate | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> Estimate | Cost to Complete | <u>Total Cost</u> |
| ` ' | Related Activities: PE 0602102F, Materials. PE 0602202F, Human Effectiveness Applied Research. | | | | | | | | | |
| (U) | PE 0603231F, Crew Systems and Personnel Protection Technology. PE 0603500F, | | | | | | | | | |
| (U) | Multi-Disciplinary Advanced Development Space Technology. | | | | | | | | | |
| (U) | PE 0604706F, Life Support Systems. This project has been coordinated through the | | | | | | | | | |
| (U) | Tri-Service Laser Hardened Materials and Structures Group and the Joint Service Agile Laser Eye Protection Program. | | | | | | | | | |
| (U) | This project has been coordinated through the Reliance process to harmonize efforts and eliminate | | | | | | | | | |
| Pro | ject 2100 | | R | -1 Shopping List - | Item No. 16-5 of 1 | 6-15 | | | Exhibit R-2a (| PE 0603112F) |

| | | DT&E Project Justification | DATE February 2004 |
|-----------|--|--|--|
| | ACTIVITY anced Technology Development (ATD) | PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems | CT NUMBER AND TITLE aser Hardened Materials |
| | Other Program Funding Summary (\$ in Millions) | | |
| dup | lication. | | |
| | Acquisition Strategy t Applicable. | | |
| | | | |
| | | | |
| | | | |
| Project 2 | 2100 | R-1 Shopping List - Item No. 16-6 of 16-15 279 | Exhibit R-2a (PE 06031 |

| | Ex | hibit R-2a, I | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|-------------------|--|--|--|---|--|---|---|--|--------------------------------------|----------------|
| | GET ACTIVITY dvanced Technology Development | (ATD) | | C | PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems | | | PROJECT NUMBER AND TITLE 3153 Non-Destructive Inspection Development | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | × , | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 3153 | Development | 8.088 | 9.956 | 4.069 | 4.103 | 4.178 | 4.249 | | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | This project develops and demonstrates a causing conditions in weapon systems co practices. Reduction in the number of fig possible. This project provides technolog field and depot maintenance levels. Equa | mponents and n ghter wings and gy to satisfy Air | aterials. NDI/ the need for ray Force requiren | E capabilities good sortie generation of the sortie generation of the sort of | greatly influence ration demand a the lifetime of | e and/or limit r an ability to per current system | nany design, n form real-time s through incre | nanufacturing, a e NDI/E more ra | and maintenance apidly than is cu | e ırrently |
| · · · | B. Accomplishments/Planned Program | | | | | | <u>F</u> Y | <u>ř 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| (U) (U) (U) | MAJOR THRUST/CONGRESSIONAL A capabilities in materials corrosion, fatigue maintenance costs. These technologies wi effort includes Congressional Adds of \$1.4 million in FY 2004 for Quantitative Inspec In FY 2003: Developed and demonstrated characterization of corrosion of joints in a cracks in multiple layers in order to meet a In FY 2004: Demonstrate and validate pul detection and characterization of corrosion methods to detect cracks in multiple layers In FY 2005: Transition advanced technolo of joints in aging aircraft. Transition adva extension requirements. | monitoring, and ll contribute to it it million in FY it advanced techni ging aircraft. De aging aircraft life sed eddy curren of joints in aging in order to mee gies for improve | testing of agin full operability 2003 for Assess s for Assessing plogies for imp eveloped and d e extension req t automated sca ng aircraft. Va t aging aircraft ed capabilities | ng aircraft to re and safety of t sing Aging of J Aging of Mili proved capabili emonstrated ac uirements. anner technolog lidate low-freq t life extension in detection an | duce operation: he aircraft fleet Military Aircraft tary Aircraft. ties in detection dvanced method gy for improved uency electrom requirements. d characterizati | s and . Note: This ft and \$3.6 n and ls to detect d capabilities in agnetic probe on of corrosion | | 2.420 | 5.276 | 1.170 |
| (U) | MAJOR THRUST/CONGRESSIONAL A capabilities to inspect for cracks and other includes a Congressional Add of \$2.5 mill of Military Aircraft. In FY 2003: Completed transition of non-o | damage to exterion in FY 2003 | nd the total saf for Quantitativ | e life of turbing e Inspection Te | e engines. Note echniques for A | e: This effort ssessing Aging | 5 | 3.726 | 2.003 | 1.595 |
| Proi | ect 3153 | | R-1 Sh | opping List - Iten | n No. 16-7 of 16-1 | 5 | | | Exhibit R-2a (I | PE 0603112F) |
| | | | | 200 200 | | | | | (- | / |

| Exhibit R-2a, RDT&E Project | DATE February 2004 | | | | |
|---|--|--|-----------------|--------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems | PROJECT NUMBER AND TITLE 3153 Non-Destructive Inspection Development | | | |
| capability of rotary components for planned life extension of engine rotors. Set extend the life of fracture-critical gas turbine engine components and identified Developed residual stress gradient measurement technologies to increase measu (U) In FY 2004: Characterize optimal non-destructive evaluation (NDE) approache gas turbine engine components and establish protocols for component inspectio (U) In FY 2005: Develop methods to detect and characterize damage in repaired (li components. Demonstrate and begin transition of optimal NDE approaches to durbine engine components. | protocols for component inspections. arement on shot peened surfaces. as to extend the life of fracture-critical ons. near friction welded) turbine engine extend the life of fracture-critical gas | | | | |
| MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate adva supporting low-observable (LO) systems to enhance affordability and ensure fu Note: This effort includes a Congressional Add of \$1.1 million in FY 2003 for | Ill performance and survivability. Handheld Holographic Radar Gun. | 1.942 | 0.000 | 1.304 | |
| (U) In FY 2003: Transitioned to the field an advanced multispectral LO NDE tool f (zone versus whole aircraft) that is real-time, small, lightweight, portable, user- frequency bands. | | | | | |
| (U) In FY 2004: Not Applicable. Note: FY 2004 efforts were delayed until FY 2000 (U) In FY 2005: Initiate the development of a portable diagnostic probe that is broad electromagnetic material properties. Initiate development of a portable, multi-ft tool for use in battle damage repair of LO materials and structures. | dband and will provide complex | | | | |
| (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate adva technologies to provide on-board and embedded sensing to gain continuous awa Note: In FY 2004, this effort includes a Congressional Add of \$1.4 million for Research (MIMR) for Air Force Systems and a Congressional Reduction of \$0. Aerospace Initiative. | areness of the state of key subsystems. Materials Integrity Management | 0.000 | 2.677 | 0.000 | |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop optimal approaches and methodologies to address the con- integrity and status for critical elements of structures/airframes, propulsion syst tankage, and wiring. | | | | | |
| (U) In FY 2005: Not Applicable.(U) Total Cost | | 8.088 | 9.956 | 4.069 | |
| Project 3153 R-1 Shopping | List - Item No. 16-8 of 16-15 | | Exhibit R-2a (F | PE 0603112F) | |

| | | | UNCE | ASSIFIED | | | | | | |
|--|---------------------------|-----------------------------------|-----------------------------------|---|-----------------------------------|---------------------|--|----------------------------|-------------------|--|
| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | DATE February 2004 | | |
| BUDGET ACTIVITY 13 Advanced Technology Develor | oment (ATD) | | | PE NUMBER A 0603112F A Weapon Sys | dvanced Mate | erials for | PROJECT NUMBER AND TITLE 3153 Non-Destructive Inspection Development | | | |
| U) <u>C. Other Program Funding Sun</u> | <u>nmary (\$ in Milli</u> | <u>ons)</u> | | | | | | | | |
| U) Related Activities: U) PE 0602102F, Materials. This project has been coordinated through the U) Reliance process to harmonize efforts and eliminate | FY 2003 Actual | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | FY 2008 Estimate | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> Complete | <u>Total Cost</u> | |
| duplication. U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Project 3153 | | R | -1 Shopping List - | Item No. 16-9 of 1 | 6-15 | | | Exhibit R-2a (| PE 0603112 | |

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justifi | ication | | | D. | ATE February | 2004 | |
|------|--|--|---|--|---|--|----------------------------------|-----------------------------|---|---------------------------------|--|
| | GET ACTIVITY dvanced Technology Development (| ATD) | | 0 | | | | | OJECT NUMBER AND TITLE | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 200 | 9 Cost to | Total | |
| | . , , | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimat | | | |
| 3946 | | 14.739 | 23.876 | 5.298 | 5.397 | 4.456 | 4.533 | | 606 Continuing | TBD | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | |
| | A. Mission Description and Budget Item This project develops and demonstrates and Advanced materials and processes that ha operating environment are performed. The initial incentives for their industrial develop B. Accomplishments/Planned Program (| <pre>dvanced materia ve matured bey is design and so opment. \$ in Millions)</pre> | ond applied res cale-up data en | earch are chara hances overall | acterized, critic affordability of | al data are colle f promising mat | ected, and crititerials and pro- | cal evaluat cessing tech | ions in the proposed hnologies, providin <u>FY 2004</u> | d g needed <u>FY 2005</u> | |
| (U) | MAJOR THRUST/CONGRESSIONAL A technologies for air vehicles and subsystem overall affordability of air vehicles. Note: Powdered Programmable Process, \$3.5 mil Bearing, and \$1.1 million for Vapor Grown \$5.0 million for the Metals Affordability Ir Air Vehicle (UAV) Components, \$2.1 mill Composites for Engines, \$2.0 million for H Technology and a Congressional Reduction In FY 2003: Fabricated and characterized i count and assembly costs. Completed the o (IR) countermeasures against far-IR laser s materials and processes for enhancing the r of advanced bearing materials for gas turbi In FY 2004: Develop an affordable high-te | hs to enhance th In FY 2003, thi lion for Cerami a Carbon Fiber. hitiative, \$1.4 m ion for Vapor C lybrid Bearings a of \$0.3 million ntegrated comp demonstration of ources and then reliability and m ne engines. | e lift, propulsio s effort include c Matrix Comp In FY 2004, the illion for Adva frown Carbon I , and \$1.0 milling n related to the posite structure f advanced non transitioned re- paintainability of | on, low-observa as Congressiona posites for Engi- nis effort includ nced Composit Fiber, \$1.8 mill on for Transpa National Aero- assemblies for n-linear optical esults. Conduc of LO systems. | able (LO) perfo al Adds of \$4.0 ines, \$1.2 milli des Congressio te Processes for lion for Cerami arent Conductiv space Initiative aircraft with re materials for a ted characteriza Accelerated th | ormance, and million for on for Hybrid nal Adds of r Unmanned ic Matrix re Polymer e. duced part ircraft infrared ation of he development | | 11.661 | 22.292 | 4.968 | |
| | components for future air vehicles to meet properties of ceramic composite materials a properties for a mid-infrared laser source es materials and inspection tools/processes to Develop and evaluate advanced fluids, lub high-speed vehicle applications. Develop a weapon system development and sustaining | cost and perform for turbine enginabling aircraft enhance reliabi ricants, and surf and assess advan | nance criteria. ne exhaust com infrared counted lity and maintan ace treatments need metallic n | Demonstrate f aponents. Idem ermeasures. De inability of low for combined on naterials and pr | fabrication proc tify materials a emonstrate imp w-observable pl cycle engine co rocessing techn | cesses and nd their proved atforms. pmponents in ologies for | | | | | |
| Proj | ect 3946 | | R-1 Sho | pping List - Item | No. 16-10 of 16- | 15 | | | Exhibit R-2a (| PE 0603112F) | |

| Exhibit R-2a, RDT&E Project Jus | stification | DATE February 2004 | | | |
|---|---|-----------------------|-----------------|-------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems | | IMBER AND TITLE | | |
| combined-cycle engine components and structures. Accelerate the development of a turbine engines. Demonstrate the capability of injection molded aircraft transparence carbon nanotubes to replace the conductivity currently provided by brittle exterior c | ties loaded with various levels of | | | | |
| (U) In FY 2005: Develop and demonstrate reliable life extension capabilities for turbine high temperature composite for turbine engine components. Validate performance is ceramic composite materials for exhaust components. Develop and characterize adv process capabilities for ultra-lightweight, ultra-high power generation for airborne d materials and demonstrate their properties for a mid-infrared laser source enabling a Validate and transition improved materials and inspection tools/processes for low-ob higher mission capable rates. | n a turbine engine environment of vanced materials and materials irected energy weapons. Develop ircraft infrared countermeasures. | | | | |
| (U) | | 2.079 | 0.402 | 0.220 | |
| (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced technologies to enhance the sustainability of Air Force aerospace systems by loweri costs and ensuring the full operability and safety of systems and personnel. Note: In Congressional Add of \$1.0 million for Advanced Material Corrosion Research for L (U) In FY 2003: Initiated efforts to develop and characterize corrosion resistant coatings | ng operations and maintenance a FY 2003, this effort includes a iquid Metal Alloys. | 3.078 | 0.493 | 0.330 | |
| compounds for aging aircraft structures applications. (U) In FY 2004: Evaluate corrosion resistant coatings and corrosion prevention compou applications. Initiate effort to determine durability and failure mechanisms of hybrid vehicles (UAVs). | | | | | |
| (U) In FY 2005: Transition corrosion resistant coatings and corrosion prevention compo- applications. Develop test methodologies and evaluation techniques to determine du mechanisms of hybrid structures in UAVs. | | | | | |
| (U) | | | | | |
| (U) CONGRESSIONAL ADD: Educate 21st Century Information Operations (IO) Work | rktorce. | 0.000 | 1.091 | 0.000 | |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Establish an Information Operations curriculum at New Mexico State U undergraduate students. | Jniversity to educate graduate and | | | | |
| (U) In FY 2005: Not Applicable. | | | | | |
| (U) Total Cost | | 14.739 | 23.876 | 5.298 | |
| | | | | | |
| | Item No. 16-11 of 16-15 | | Exhibit R-2a (P | E 0003112F) | |

| | UNCLASSIFIED | | | |
|---|--|--|--|--|
| Exhibit R-2a, RDT&E | Project Justification | DATE February 2004 | | |
| BUDGET ACTIVITY 3 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems | PROJECT NUMBER AND TITLE 3946 Materials Transition | | |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | | | |
| U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | |
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| | | | | |
| Project 3946 R- | -1 Shopping List - Item No. 16-12 of 16-15 | Exhibit R-2a (PE 060311 | | |

| (U) MAJOR THRUST: Demonstrate and transition affordable, rapid deployment technologies that ensure military readiness, maintain aerospace missions, support advanced weapon systems, and enable peacetime training operations. Note: In FY 2004, remaining activities in this thrust will be integrated into the other major thrusts in this project. (U) In FY 2003: Furthered the development of advanced waste reactor technologies to support emerging weapons. Demonstrated rapidly deployable full-scale mixed-base hydrogen peroxide production plant. (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. | DATE | February | 2004 | |
|---|--|-------------------------|-------------------------|--|
| Cost (\$ in Millions) Actual Estimate Estimate Estimate Estimate Estimate 4918 Deployed Air Base Demonstrations 3.718 11.104 2.366 2.386 2.429 2.470 Quantity of RDT&E Articles 0 <td< th=""><th colspan="4">PROJECT NUMBER AND TITLE 4918 Deployed Air Base Demonstrations</th></td<> | PROJECT NUMBER AND TITLE 4918 Deployed Air Base Demonstrations | | | |
| 4918 Deployed Air Base Demonstrations 3.718 11.104 2.366 2.386 2.429 2.470 Quantity of RDT&E Articles 0 0 0 0 0 0 0 0 (U) A. Mission Description and Budget Item Justification This project supports the Aerospace Expeditionary Forces (AEF) through development and demonstration of advanced, rapidly dep airlift and manpower requirements, setup times, and sustainment costs and improve protection and survivability of deployed AEF were technologies are developed and demonstrated to provide deployable infrastructure, advanced weapon system support, force protect deployed AEF warfighters. (U) B. Accomplishments/Planned Program (\$ in Millions) FY (U) MAJOR THRUST: Demonstrate and transition affordable, rapid deployment technologies that ensure military readiness, maintain aerospace missions, support advanced weapon systems, and enable peacetime training operations. Note: In FY 2004, remaining activities in this thrust will be integrated into the other major thrusts in this project. (U) (U) In FY 2003: Furthered the development of advanced waste reactor technologies to support emerging weapons. Demonstrated rapidly deployable full-scale mixed-base hydrogen peroxide production plant. (U) (U) In FY 2005: Not Applicable. (U) In FY 2005: Not Applicable. | FY 2009 Estimate | Cost to Complete | Total | |
| Quantity of RDT&E Articles 0 0 0 0 0 0 0 0 0 0 0 (U) A. Mission Description and Budget Item Justification This project supports the Aerospace Expeditionary Forces (AEF) through development and demonstration of advanced, rapidly dep airlift and manpower requirements, setup times, and sustainment costs and improve protection and survivability of deployed AEF v technologies are developed and demonstrated to provide deployable infrastructure, advanced weapon system support, force protect deployed AEF warfighters. (U) B. Accomplishments/Planned Program (\$ in Millions) FY (U) MAJOR THRUST: Demonstrate and transition affordable, rapid deployment technologies that ensure military readiness, maintain aerospace missions, support advanced weapon systems, and enable peacetime training operations. Note: In FY 2004, remaining activities in this thrust will be integrated into the other major thrusts in this project. (U) In FY 2003: Furthered the development of advanced waste reactor technologies to support emerging weapons. Demonstrated rapidly deployable full-scale mixed-base hydrogen peroxide production plant. (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. U) In FY 2005: Not Applicable. | | | TBD | |
| This project supports the Aerospace Expeditionary Forces (AEF) through development and demonstration of advanced, rapidly depairlift and manpower requirements, setup times, and sustainment costs and improve protection and survivability of deployed AEF were technologies are developed and demonstrated to provide deployable infrastructure, advanced weapon system support, force protect deployed AEF warfighters. (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> (U) MAJOR THRUST: Demonstrate and transition affordable, rapid deployment technologies that ensure military readiness, maintain aerospace missions, support advanced weapon systems, and enable peacetime training operations. Note: In FY 2004, remaining activities in this thrust will be integrated into the other major thrusts in this project. (U) In FY 2003: Furthered the development of advanced waste reactor technologies to support emerging weapons. Demonstrated rapidly deployable full-scale mixed-base hydrogen peroxide production plant. (U) In FY 2005: Not Applicable. | 1 | | | |
| (U) MAJOR THRUST: Demonstrate and transition affordable, rapid deployment technologies that ensure military readiness, maintain aerospace missions, support advanced weapon systems, and enable peacetime training operations. Note: In FY 2004, remaining activities in this thrust will be integrated into the other major thrusts in this project. (U) In FY 2003: Furthered the development of advanced waste reactor technologies to support emerging weapons. Demonstrated rapidly deployable full-scale mixed-base hydrogen peroxide production plant. (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. | warfighters. Ef | ficient and cost- | effective | |
| | <u>7 2003</u> 0.101 | <u>FY 2004</u> 0.000 | <u>FY 2005</u> 0.000 | |
| (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: Demonstrate and transition advanced rapid deployment airbase technologies that reduce airlift and manpower requirements, setup times, and sustainment costs in support of AEF operations. Note: In FY 2003, this effort includes a Congressional Add of \$1.8 million for Tyndall Air Force Research Laboratory. In FY 2004, this effort includes Congressional Adds of \$3.4 million for Plasma Arc/Waste to Energy Production and \$1.4 million for Polymer Technology for Agile Combat Support. (U) In FY 2003: Enhanced the development of shelters, power, and rapid airfield assessment technologies that improve system performance and reduce airlift requirements in support of AEF operations. Developed advanced aircraft firefighting technologies such as firefighting agents and equipment. Transitioned a highly effective, deployable crash/rescue system based on three-dimensional foam technology to support AEF operations. Note: In FY 2003, the deployable firefighting technology activities in this major thrust were moved to the force protection major thrust in this project. (U) In FY 2004: Transition air-inflatable shelter technology to support logistics footprint reduction in AEF operations. Develop 10KW fuel cell power system that improves deployable power system performance and reduces airlift | 2.215 | 6.500 | 1.432 | |
| requirements for AEF operations. Demonstrate rapid airfield assessment and repair technologies that improve | | | | |
| Project 4918 R-1 Shopping List - Item No. 16-13 of 16-15 | | Exhibit R-2a (F | <u>PE 0603112F)</u> | |

| | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | DATE | February | 2004 |
|---|---|--|---|--|---|-----------------------------------|---------------------|-----------------------------------|-------------------|
| BUDGET ACTIVITY 03 Advanced Technology Develo | opment (ATD) | | | PE NUMBER A 0603112F A Weapon Sys | dvanced Mate | erials for | | IBER AND TITLE | 2004 |
| performance and enhance AEF of (U) In FY 2005: Continue development and reduces airlift requirements f airfield assessment and repair tec requirements for support of AEF (U) | ent of a 10KW fuel for support of Aeros hnologies that imp | space Expedition | nary Forces (AE | F) operations. T | ransition rapid | ce | | | |
| (U) MAJOR THRUST/CONGRESSI provide force protection to deploy Congressional Adds of \$3.0 milli Network and \$1.5 million for Mc (U) In FY 2003: Developed deployab warfighters. (U) In FY 2004: Demonstrate deploy warfighters. Develop a reduced-self-sterilizing coatings and lamin for airbase protection. Evaluate a deployable firefighting technolog (U) In FY 2005: Transition deployab warfighters. Demonstrate a reduced-self-sterilizing coatings and lamin | yed AEF warfighte on for Environmen elecular Marking of ole protective and a able protective and size full-capability nates for expedition molecular tagging t activities were maile protective and ac ced-size full-capability | rs and infrastruc ital Sensing and Explosives. dvanced blast su advanced blast firefighting vehi- nary structures. echnology for ex- loved into this m dvanced blast su ility firefighting | ture. Note: In F Monitoring Syst appression techno suppression tech icle for deployed Demonstrate sys xplosive materia najor thrust. ppression techno | Y 2004, this effe ems (E-SMART ologies to protec nologies to prot operations. De tem to integrate ls. Note: In FY logies to protect | ort includes T) Threat Agent et deployed ect deployed evelop threat sensor da 2003, the t deployed | | 1.402 | 4.604 | 0.934 |
| U) Total Cost | - | | | | | | 3.718 | 11.104 | 2.366 |
| (U) <u>C. Other Program Funding Su</u> (U) Related Activities: (U) PE 0602102F, Materials. (U) PE 0604617F, Agile Combat Support. This project has been coordinated through the (U) Reliance process to harmonize | <u>mmary (\$ in Milli</u> <u>FY 2003</u> <u>Actual</u> | <u>ons)</u> <u>FY 2004</u> <u>Estimate</u> | FY 2005 Estimate | <u>FY 2006</u> <u>Estimate</u> | FY 2007 Estimate | <u>FY 2008</u> <u>Estimate</u> | FY 2009 Estimate | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| efforts and eliminate duplication. Project 4918 | | R- | 1 Shopping List - I | tem No. 16-14 of 2 | 16-15 | | | Exhibit R-2a | PE 0603112F |

| Exhibit R-2 | 2a, RDT&E Project Justification | DATE February 2004 |
|--|--|--|
| DGET ACTIVITY Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems | PROJECT NUMBER AND TITLE 4918 Deployed Air Base Demonstrations |
| D. Acquisition Strategy Not Applicable. | | |
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| | | |
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| | | |
| | | |
| | | |
| Project 4918 | R-1 Shopping List - Item No. 16-15 of 16-15 | Exhibit R-2a (PE 0603112 |

PE NUMBER: 0603203F PE TITLE: Advanced Aerospace Sensors

| | Exhibit R-2, RDT&E Budget Item Justification | | | | | | | | | 2004 |
|------|---|---------|----------|----------|----------|----------|----------|----------|------------|-------|
| | DGET ACTIVITY PE NUMBER AND TITLE Advanced Technology Development (ATD) 0603203F Advanced Aerospace Sensors | | | | | | | 'S | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ III WIIIIOIIS) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| | Total Program Element (PE) Cost | 50.988 | 41.124 | 30.634 | 34.010 | 42.947 | 39.603 | 39.426 | Continuing | TBD |
| 5019 | Advanced RF Technology for ISR Sensors | 4.414 | 4.904 | 3.577 | 4.386 | 4.587 | 5.449 | 5.536 | Continuing | TBD |
| 665A | Advanced Aerospace Sensors Technology | 11.469 | 14.826 | 10.754 | 9.617 | 10.718 | 10.897 | 11.072 | Continuing | TBD |
| 69DF | Target Attack and Recognition Technology | 35.105 | 21.394 | 16.303 | 20.007 | 27.642 | 23.257 | 22.818 | Continuing | TBD |

Note: In FY 2003, efforts in advanced radio frequency (RF) technologies for intelligence, surveillance, and reconnaissance (ISR) sensors previously performed in this PE, Project 665A, transferred to Project 5019. Also in FY 2003, space unique tasks in this PE, Project 665A, transferred to PE 0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description and Budget Item Justification

Divided into three broad project areas, this program develops technologies to enable the continued superiority of sensors from aerospace platforms. The first project develops and demonstrates advanced technologies for RF sensors for aerospace ISR systems. The second project develops and demonstrates advanced technologies for electro-optical (EO) sensors, radar sensors and electronic counter-countermeasures, and components and algorithms. The third project develops and demonstrates RF and EO sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets obscured by natural or man-made means. Together, the projects in this program develop the means to find, fix, target, track, and engage air and ground targets anytime, anywhere, and in any weather. Note: In FY 2004, Congress added \$5.0 million for the National Operational Signature Production and Research Capability. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and electronic combat system developments that have military utility and address warfighter needs.

R-1 Shopping List - Item No. 17-1 of 17-15

| Exhibit R-2, RDT&E Bud | dget Item Justification | DATE February 2004 | | |
|---|--|-----------------------|---------------|--|
| UDGET ACTIVITY 3 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors | | | |
| U) <u>B. Program Change Summary (\$ in Millions)</u> | | | | |
| | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 200</u> | |
| J) Previous President's Budget | 52.482 | 36.550 | 30.71 | |
| Current PBR/President's Budget | 50.988 | 41.124 | 30.63 | |
| 1) Total Adjustments | -1.494 | 4.574 | | |
|) Congressional Program Reductions | | -0.074 | | |
| Congressional Rescissions | | -0.352 | | |
| Congressional Increases | 0.110 | 5.000 | | |
| Reprogrammings | -0.110 | | | |
| SBIR/STTR Transfer () Significant Program Changes: | -1.384 | | | |
| | | | | |
| | | | | |
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R-1 Shopping List - Item No. 17-2 of 17-15

| | Ex | DATE | DATE February 2004 | | | | | | | | |
|--|---|---|---|--|--|---|------------------------------|--|-------------------------|-------------------------|--|
| | ET ACTIVITY Ivanced Technology Development | (ATD) | | Q | PE NUMBER AND D603203F Adv Sensors | | space | PROJECT NUMBER AND TITLE 5019 Advanced RF Technology for ISR Sensors | | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total | |
| 5019 | Advanced RF Technology for ISR Sensors | 4.414 | 4.904 | 3.577 | | 4.587 | 5.449 | | Continuing | TBD | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| | A. Mission Description and Budget Iter This project develops and demonstrates F environments. This project provides the ground-based, high-value, time-critical ta sensor capabilities (including integrated e | RF aerospace sur warfighter with rgets. Work inc | sensors capabl ludes developi | e of detecting a ing aerospace e | and tracking bo environmentally | th airborne (con y-qualified (vib | ventional and ration, shock, | l low radar cross temperature, and | s section) and | | |
| (U) M (() (U) H a d (U) H ta (U) H f f g | B. Accomplishments/Planned Program MAJOR THRUST: Develop techniques for GMTI), and foliage penetrating ground ta n FY 2003: Configured data collection of dvanced air moving target indication, GM lesign a flexible testbed using a manned to n FY 2004: Collect data for multi-intellig arget indication. Mature the design for a lesign review level. n FY 2005: Validate data collected for ai oliage-obscured ground target indication round and air targets under multi-intellig nitiate plans for an experiment that will v | or advanced air : rrget indication. pportunities usin (TI, and foliage est aircraft to de gence air moving flexible testbed r moving target through compute ence waveform, | g existing asse penetrating gr monstrate mult g target indicat demonstrating indication, gro er simulation a pulse repetitio | ets for validation ound target ind ti-intelligence s ion, GMTI, and multi-intellige ound moving ta nd emulation to n frequency, and | on of techniques lication. Initiate surveillance. d foliage-obscu nce surveillance rget indication a echniques for d nd signal proces | s generated for ed an effort to red ground e to the critical and iscerning | | <u>Y 2003</u> 0.882 | <u>FY 2004</u> 1.081 | <u>FY 2005</u> 1.642 | |
| (U) M (U) H iii a (U) H | AJOR THRUST: Develop multi-intellig n FY 2003: Conducted in-house develop n aperture development, signal processing ir targets under conditions of common pu n FY 2004: Complete the design of a mu imulations. Validate the system through | ment of a multi- g, and radar desi ilse repetition fre lti-intelligence s | intelligence se gn. Developec equencies, wav urveillance sys | l techniques for reforms, and re stem and mode | r discriminating ceiver systems. l it in mission a | g ground from rea | | 1.451 | 1.271 | 0.000 | |
| Proje | ct 5019 | | R-1 Sh | opping List - Iten | n No. 17-3 of 17-1 | 15 | | | Exhibit R-2a (| PE 0603203F) | |
| | | | | 292 | 1 | | | | | | |

| Exhibit R-2a, | , RDT&E Project Justification | D | ATE February | 2004 |
|--|---|-------|---|--------------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603203F Advanced Aero Sensors | | IUMBER AND TITLE anced RF Techr ors | ology for |
| experiment that will validate electronic protection signal systems. | etition frequency, and signal processing scenarios. Plan an l processing techniques for multi-intelligence data collection | | | |
| (U) In FY 2005: Not Applicable. Work completed.(U) | | | | |
| (U) MAJOR THRUST: Develop and demonstrate advanced jamming interference, and improve detection and tracking | | 1.406 | 1.049 | 1.101 |
| (U) In FY 2003: Developed knowledge-aided radar signal p control performance in ground moving target indication processing techniques and knowledge-aided radar signal architectures, and demonstrated these techniques for mu | (GMTI) sensors. Implemented multi-dimensional adaptive processing techniques on selected advanced computing | 1 | | |
| (U) In FY 2004: Demonstrate and evaluate knowledge-aided and false alarm control performance in GMTI sensors. C multi-mission conformal arrays and wideband and polar | | | | |
| techniques for multi-mission conformal arrays and wide | d radar signal processing techniques for improved detection e sensors. Demonstrate and evaluate adaptive processing band and polarization adaptive processing techniques for chitectures for multi-mission aerospace radar applications. | | | |
| (U) | ······································ | | | |
| (U) MAJOR THRUST: Develop and demonstrate photonic architectures. | digital and analog mixed signal multi-gigahertz component | 0.675 | 0.257 | 0.000 |
| (U) In FY 2003: Developed and integrated chip-scale photo (RF) signal generation, phased array antenna beam form high-resolution wide bandwidth photonic wavelength div Provided performance modeling, verification, and analys unique applications. | ation, and beam control. Developed and demonstrated | 7 | | |
| government-sponsored and independent research. | modeling, verification, and analyses of photonic and hybrid rray antenna beam formation, and beam control, in support o | | | |
| (U) In FY 2005: Not Applicable.(U) | | | | |
| (U) MAJOR THRUST: Develop and demonstrate technique | es to surveil venues denied to standoff intelligence, | 0.000 | 1.246 | 0.834 |
| Project 5019 | R-1 Shopping List - Item No. 17-4 of 17-15 | | Exhibit R-2a (| PE 0603203F) |
| | 202 | | | |

292

| | Exhibit R-2a, RDT&E Project Justification | | | | | | | | DATE February 2004 | | |
|---|--|---|--|--|---|---------------------|----------------------|---|-----------------------|--|--|
| BUDGET ACTIVITY 03 Advanced Technology Develor | pment (ATD) | | | 0603203F Advanced Aerospace 501 | | | | ROJECT NUMBER AND TITLE 019 Advanced RF Technology for SR Sensors | | | |
| surveillance, and reconnaissance p (U) In FY 2003: Not Applicable. (U) In FY 2004: Initiate developing te reconnaissance (ISR) platforms. T buildings, and heavily concealed ta Specifically, the effort will concen frequency (RF) phenomenologies. (U) In FY 2005: Continue developing short-range, low-cost, expendable | echniques to surve The emphasis is or argets that use adv ntrate on short-ran; techniques to sur | n denied access a vanced camoflau ge, low-cost, exp veil venues deni | areas, such as ur ige, concealmen pendable sensor ed to standoff Is | ban canyons, in t, and deception s that can exploi SR platforms, co | her areas of techniques. t multiple radio | | | | | | |
| (U) Total Cost | | | | | | | 4.414 | 4.904 | 3.577 | | |
| (U) <u>C. Other Program Funding Sum</u> (U) Related Activities: PE 0602204F, Aerospace Sensors. | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | <u>FY 2</u> Estin | <u>.009 Cost</u> mate <u>Compl</u> | - I OTAL COST | | |
| PE 0603270F, Electronic Combat Technology. PE 0603500F, Multi-disciplinary Advanced | | | | | | | | | | | |
| (U) PE 0604270F, Electronic Warfare (EW) Development. This project has been coordinated through the | | | | | | | | | | | |
| (U) Reliance process to harmonize efforts and eliminate duplication. | | | | | | | | | | | |
| (U) D. Acquisition Strategy Not Applicable. | | | | | | | | | | | |
| Project 5019 | | R | -1 Shopping List - | Item No. 17-5 of 1 | 7-15 | | | Exhibit R- | 2a (PE 0603203F) | | |

| Exhibit R-2a, RDT&E Project Justification | | | | | | | DATE February 2004 | | | |
|--|---|---|--|--|---|----------------------------------|---|---------------------|--------------------------------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | | | | PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors | | | PROJECT NUMBER AND TITLE 665A Advanced Aerospace Sensors Technology | | | |
| Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total | |
| 665A Advanced Aerospace Sensors Technology | 11.469 | 14.826 | 10.754 | 9.617 | 10.718 | 10.897 | 11.072 | Continuing | TBD | |
| Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| (U) <u>A. Mission Description and Budget It</u> This project develops and demonstrates radar sensors, and electronic counter-co (conventional and low radar cross section combat technology. Desired warfightin | em Justification aerospace sensor untermeasures fo on) and ground-ba | r radars. It pro ased, high-valu | ovides aerospace le, time-critical | e platforms wit targets. Projec | h the capability t activities incl | to precisely d ude developing | etect, track, and g multi-function | l target both air | borne | |
| (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> | | | | FY | | 2003 | FY 2004 | <u>FY 2005</u> | | |
| (U) MAJOR THRUST: Develop integrated I targets at ranges significantly longer than low-observable, or employ other means of (U) In FY 2003: Completed fabricating and the Assessed real-time data processing perfort (U) In FY 2004: Extend performance of group aircraft integration components. Extend a demonstration sensor with integrated key (U) (U) MAJOR THRUST: Develop EO sensor the aerospace ISR applications. (U) In FY 2003: Completed fabricating and the Performed flight characterization. Assess (U) In FY 2004: Extend performance of a deministry spectral sensing capability. Fabrication and the missive spectral sensing capability for demonstrate sensing capability. | currently achiev of deception. testing a ground of rmance. and demonstration design to integrate passive cueing in systems for mode technologies to de testing a demonstration sense monstration senses ricate, laboratory sting of demonst | able, including lemonstration and n sensor to flying the key subsystee an airborne en- lular testing to etect and locate tration sensor f ed data process or for high alti- y integrate, and ration system f | targets that are sensor and aircr ing test-bed con ms for modular nvironment. Ex flying test-bed e camouflaged or high altitude sing performan- tude reconnaiss test emissive s for high-altitude | e camouflaged, raft integration afiguration. Gra- testing. stend performat configuration. and concealed to reconnaissance ce. sance aircraft to pectrometer co e aircraft with in | design. ound test nce of ground targets for e aircraft. o incorporate an mponents. ncorporation of | | 3.166 3.260 | 3.316 3.682 | 2.104 4.732 | |
| Project 665A R-1 Shopping List - Item No. 17-6 of 17-15 | | | | | | | | Exhibit R-2a (| PE 0603203F) | |
| | | | 294 | | | | | ` | <i>`````````````````````````````</i> | |

| | Exhibit R-2a, RDT&E Proj | DA | DATE February 2004 | | | |
|------------|---|--|-----------------------|---|--------------|--|
| | GET ACTIVITY Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors | 665A Adva | PROJECT NUMBER AND TITLE 665A Advanced Aerospace Sensors Technology | | |
| | transition to acquisition center. | | | | | |
| (U) (U) | MAJOR THRUST: Develop advanced electro-optical sensor technology for In FY 2003: Completed design and initiated developing a multi-function la In FY 2004: Complete developing and demonstrate a multi-function laser based on target geometry and vibration. | aser for air and ground target identification. | 0.809 | 0.941 | 0.000 | |
| (U) (U) | In FY 2005: Not Applicable. Work completed. | | | | | |
| (U) (U) | MAJOR THRUST: Develop technologies to maximize Global Positioning accuracy, timing accuracy, and exploitation techniques to improve offensiv In FY 2003: Developed advanced GPS M-Code technologies. Developed operate GPS in buildings, underground, and in air and space to provide pre | ve and defensive combat capabilities. reference technologies to adaptively | 1.210 | 1.215 | 0.911 | |
| (U) | multiple platforms. Developed virtual flight test technology for improved a In FY 2004: Demonstrate precise reference aerospace sensing technologie buildings. Design geo-registration technologies to maximize navigation we offensive and defensive combat capabilities. Develop virtual flight test sin GPS anti-jam techniques. | s to adaptively operate underground and in arfare exploitation techniques for enhanced | | | | |
| (U) | In FY 2005: Design critical experiments for assured reference technologie accuracy, and exploitation techniques for network centric engagement. De data registration technology for improved geo-location performance. Expa for improved assessment of precise reference sensing networks. | velop automatic multi-intelligence sensor | | | | |
| (U) | 1 | | | | | |
| | MAJOR THRUST: Develop, test, evaluate, and demonstrate the radio free detect, track, and target high-value, time-critical targets that are difficult to concealment. | | 1.828 | 0.393 | 2.617 | |
| (U) | In FY 2003: Evaluated "mini" unmanned aerial vehicle (UAV) concept of improvements in the detection, tracking, and targeting of high-value, time- | | | | | |
| (U) | In FY 2004: Laboratory test "mini" UAV concept of operation and RF sen detection, tracking, and targeting of high-value, time-critical targets. | • | | | | |
| (U) | In FY 2005: Demonstrate in the laboratory evolved multi-intelligence tech of operation and RF sensor performance improvements in the detection, tra time-critical targets. Develop RF receiver technologies to detect, character the detection, and location of high-value, time-critical targets. | acking and targeting of high-value, | | | | |
| (U) | | | | | | |
| Proj | ect 665A R-1 Shop | oping List - Item No. 17-7 of 17-15 | | Exhibit R-2a (| PE 0603203F) | |

| | Exhibit R-2a, RDT&E Project Justification | | | | | | | | DATE February 2004 | | |
|---|--|--|--|--|---|---|-----------------------------------|-----------------------------------|--|-------------------|--|
| | 03 Advanced Technology Development (ATD) 0603203F Advanced Aerospace | | | | | | | | IECT NUMBER AND TITLE A Advanced Aerospace Sensor Innology | | |
| (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 | MAJOR THRUST: Develop weapo In FY 2003: Developed a concept d applications. In FY 2004: Develop advanced rad performance of weapons-guidance of control radar and weapon system sir In FY 2005: Evaluate advanced rad guidance quality track radar perform control radar and weapon system sir | lefinition and a s ar techniques, su quality in advance nulation model t ar techniques, su nance in advance | b-system analysis b-systems, and red jamming enviro to evaluate syste ab-systems and red jamming enviro | of a fire control methods to estal vironments. Devem and sub-syste methods to estab ironment. Valid | radar system for blish and mainta rise integrated h m requirements blish and maintai ate and test high | in track radar igh-fidelity fire and performance in weapons fidelity fire | | 0.233 | 0.406 | 0.390 | |
| (U) I (U) I (U) I (U) I t t (U) I | MAJOR THRUST: Develop techno In FY 2003: Not Applicable. In FY 2004: Define a technically fe the Hypersonic Reconnaissance/Atta tool. Recommend airframe configur platform in a hypersonic environme. In FY 2005: Not Applicable. Work | asible, operation ack Vehicle. De rations that will nt. | nally effective servelop a feasibil | ensor suite and c ity analysis and s | oncept of operat | tions for use on nce simulation | | 0.000 | 4.873 | 0.000 | |
| (U) I 5 (U) I | CONGRESSIONAL ADD: Advance In FY 2003: Demonstrated depositi substrates to enable advanced physic In FY 2004: Not Applicable. In FY 2005: Not Applicable. | on techniques fo | or high growth r | ate, high-quality | silicon carbide | semiconductor | | 0.963 | 0.000 | 0.000 | |
| (U) 7 | Total Cost | | | | | | | 11.469 | 14.826 | 10.754 | |
| | C. Other Program Funding Sumr Related Activities: | nary (\$ in Milli FY 2003 Actual | ons) FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> | |
| (U) (U) | PE 0602204F, Aerospace Sensors. PE 0603205F, Flight Vehicle Technology. PE 0603707F, Weather Systems | | | | | | | | | | |
| Proje | ect 665A | | R | R-1 Shopping List - | <u>Item No. 17-8 of 1</u> 296 | 17-15 | | | Exhibit R-2a | (PE 0603203F) | |

| Exhibit R-2 | DATE February 2004 | | | |
|---|---|--------------------------|--|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | | | | |
| (U) <u>C. Other Program Funding Summary (\$ in Millio</u> | <u>ns)</u> | | | |
| Advanced Development. | | | | |
| PE 0603500F, | | | | |
| Multi-disciplinary Advanced | | | | |
| (U) Development Space | | | | |
| Technology. | | | | |
| PE 0602111N, Weapons | | | | |
| (U) Technology. | | | | |
| PE 0602232N, Space and | | | | |
| (U) Electronic Warfare (SEW) | | | | |
| Technology. | | | | |
| (U) PE 0604249F, LANTIRN Night | | | | |
| Precision Attack. | | | | |
| (U) PE 0603270F, Electronic | | | | |
| Combat Technology. | | | | |
| A Memorandum of Agreement | | | | |
| has been established between | | | | |
| Air Force Research Laboratory | | | | |
| and Defense Advanced Research | | | | |
| (U) Projects Agency to jointly | | | | |
| develop the technology required | | | | |
| to detect high-value, | | | | |
| time-critical targets in a variety | | | | |
| of environments. | | | | |
| This project has been | | | | |
| coordinated through the | | | | |
| (U) Reliance process to harmonize | | | | |
| efforts and eliminate | | | | |
| duplication. | | | | |
| (U) <u>D. Acquisition Strategy</u> | | | | |
| Not Applicable. | | | | |
| ** | | | | |
| | | | | |
| Project 665A | R-1 Shopping List - Item No. 17-9 of 17-15 297 | Exhibit R-2a (PE 0603203 | | |

| Exhibit R-2a, RDT&E Project Justification | | | | | | | | DATE | February | 2004 |
|---|---|---|--|---|--|---|--|--|--|--|
| | BUDGET ACTIVITY PE NUMBER AND TI 13 Advanced Technology Development (ATD) 0603203F Advan Sensors | | | | | | pace | PROJECT NUME 69DF Target Technology | BER AND TITLE | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | · · · | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 69DI | Technology | 35.105 | 21.394 | 16.303 | 20.007 | 27.642 | 23.257 | 22.818 | Continuing | TBD |
| | Quantity of RDT&E Articles In FY 2003, efforts in advanced radio fro | 0 | 0 | 0 | 0 | 0 | 0 | , , , , , , , , , , , , , , , , , , , | | |
| (U) | A. Mission Description and Budget Ite This project develops and demonstrates a demonstrating integrated and cooperative weapon launch ranges. Specific fire con low radar cross section threats, and targe missile defense efforts in surveillance an project also develops and demonstrates ta and ground-based, high-value, time-critic air-to-surface weapon systems so they ar vision algorithms and target signature de partnership with the Defense Advanced I control and recognition technologies dev capabilities largely through software imp | advanced technol e fire control tech trol technologies ting using both o d attack. These arget identification cal targets at long the able to operate velopment techn Research Projects eloped and demo | under develop under develop in-board and of fire control tec on and recogni ger ranges than in all weather iques are the k s Agency, and onstrated in thi | vide for adverse oment include a ff-board sensor hnologies will tion technologi are currently p conditions, dur ey to target ide evaluating the s project are hi | e-weather preci- attack managem information. The provide force noises for positive, possible. The gring day or nigh- entification and techniques to sigh leverage effor- | sion air strikes nent, sensor fusi This project also nultiplication an high confidence oal is to apply nt, and in high-t recognition. T upport theater r orts, providing | against multip ion, automated o evaluates tar nd reduce warf e cueing, reco these technolo hreat, multiple his project is r nissile defense for significant | le targets per pa l decision aids, a geting technique fighter exposure ognition, and ide gies to tactical a e target environm naturing these to e efforts in surve advancements | advanced tracki advanced tracki es to support the to hostile fire. entification of a air-to-air and ments. Model- echnologies in eillance and atta in operational | mum ing for eater This irborne based ack. Fire |
| (U) (U) (U) | B. Accomplishments/Planned Program MAJOR THRUST: Develop modeling an capability for warfighters, as enabled by a prosecution of time-critical targets. In FY 2003: Employed the modeling, sim recognition (ATR) and information fusion missions where weather, terrain, foliage, of interest. Developed and employed air and signature exploitation in automatic target signatures for automated signature exploit In FY 2004: Demonstrate the analysis tes data and processes. Continue developing a | nd simulation to solutomated targeti nulation, and anale a algorithms for t camouflage, and l ground target si recognizer and n tation of RF and otbed in operation | ng technologie lysis testbed to ime-critical tar deception tech gnature genera nulti-sensor fus electro-optical nally realistic e | es for rapid deter o analyze and de rgeting, emphas niques obscure ation models to sion algorithms sensor data. nvironments, u | ection, location, emonstrate auto sizing the diffic e or conceal the support autom b. Generated sy using operationa | , and omatice target cult targeting targets of ated target nthetic target ally realistic | E | <u>7 2003</u> 1.236 | <u>FY 2004</u> 1.133 | <u>FY 2005</u> 1.586 |
| Proj | ect 69DF | | R-1 Sho | opping List - Item | No. 17-10 of 17- | 15 | | | Exhibit R-2a (| PE 0603203F) |

| Exhibit R-2a, RDT&E Pi | DA | DATE February 2004 | | | |
|--|---|-----------------------|--|--------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors | 69DF Targ | PROJECT NUMBER AND TITLE 69DF Target Attack and Recognition Technology | | |
| support automated target signature exploitation in automatic target reco Continue generating synthetic target signatures for automated signature electro-optical (EO) sensor data. | | | | | |
| (U) In FY 2005: Initiate an analysis of an enhanced capability to find and target recognition processing in the Distributed Common Ground Static capability to find and track targets under trees and camouflage by empl automated sensor fusion technologies. Continue developing and employ models to support automated target signature exploitation in automatic algorithms. Continue generating synthetic target and scene signatures for EO sensor data. Analyze advanced ground target signature generation | on. Complete an analysis of an enhanced oying Foliage Penetration Radar and oying air and ground target signature generation target recognizer and multi-sensor fusion for automated signature exploitation of RF and | | | | |
| (U) | | | | | |
| (U) MAJOR THRUST: Develop common open system technology integra out-of-the-cockpit to improve aircrew combat and joint battlespace situ target engagement capabilities. | | 1.818 | 1.328 | 1.842 | |
| (U) In FY 2003: Demonstrated initial capability to fuse all-source threat, in | | | | | |
| an airborne platform digitally linked to airborne combat search and reso | | | | | |
| (U) In FY 2004: Incrementally upgrade common situational awareness oper below line-of-sight threat geo-location and threat awareness receiver sy defense system threat intent data for enhancing in-flight threat response capabilities. Demonstrate a laboratory capability to fuse all-source thread data for use across special operations and other tactical aviation platfor system components to assess system performance capabilities in low-all | e options and aircraft self-protection eat, target, survivor location, and threat intent ms. Conduct limited flight evaluations of key | | | | |
| (U) In FY 2005: Integrate and flight-test common situational awareness test special operations aircraft to assess integrated system performance capa product maturity levels. Initiate a laboratory incremental development to transition of common situational awareness system components with sp both fixed-wing and vertical lift aircraft. | abilities, aircrew workload reduction, and technology product approach to match | | | | |
| (U) | | | | | |
| (U) MAJOR THRUST: Develop and test an automatic target recognition (moving and stationary ground targets for use in strike and reconnaissant) | ce platforms. | 5.160 | 2.686 | 2.374 | |
| (U) In FY 2003: Integrated advanced stationary target identification techni radar processing. Advanced the state-of-the-art for moving target ident providing technology maturation and risk reduction. Continued analysi reduction for transition via planned sensor upgrades to strike and recom- | ification techniques and algorithms by is of requirements and affordable risk | | | | |
| Project 69DF R-1 S | hopping List - Item No. 17-11 of 17-15 | | Exhibit R-2a (F | PE 0603203F) | |
| | 299 | | | | |

| | Exhibit R-2a, RDT&E Proje | | DATE February | 2004 | |
|-----|--|--|---|-----------------|--------------|
| | OGET ACTIVITY Advanced Technology Development (ATD) | | CT NUMBER AND TITLE Target Attack and Recognition | | |
| | In FY 2004: Demonstrate a stationary ground target classification and ident techniques in real-time in a laboratory setting using operational computer ha and perform transition risk reduction tasks for integrating this capability into platforms. Develop advanced moving target classification and identification integration with high range resolution radar and other moving target indication | ardware devices. Develop transition plans o operational strike and reconnaissance n techniques and algorithms for ion processing techniques. | | | |
| | In FY 2005: Finalize transition plans for advanced stationary target identified developed in the laboratory with synthetic aperture radar processing. Continer risk reduction for transition of advanced moving target classification and identification techniques and algorithms for integration with moving target indication processing techniques. | nue analyzing requirements and affordable entification techniques and algorithms via leveloping advanced moving target | | | |
| (U) | | | | | |
| (U) | MAJOR THRUST: Develop multi-sensor automatic target recognition (AT reconnaissance (ISR), strike, and weapon systems. | R) for Air Force intelligence, surveillance, | 3.766 | 3.689 | 5.127 |
| | In FY 2003: Tested and integrated Air Force and Defense Advanced Resear multi-sensor ATR fusion algorithms into the Air Force ATR evaluation test strike, and weapon systems. Characterized single and multi-sensor contribu (including hyperspectral imaging) sensors with automated exploitation. Cor and Air Operation Centers decision makers, the impact of automated multi-se timeline reductions for time-critical targeting. | facility for application to Air Force ISR, tions from radar and electro-optical ntinued demonstrating, to image analysts sensor ATR and fusion capability on | | | |
| (U) | In FY 2004: Assess the performance of Air Force and DARPA multi-sensor Force ATR evaluation test facility. Continue characterizing both single and and electro-optical (including hyperspectral imaging) sensors with automate to automate data collection planning for transition of algorithms. Improve A and networking infrastructure via software, hardware, and network integratic capabilities and expand DoD-wide repository of research and development (computational and collaborative environment to accelerate the transition of A Utilize synthetic data generation capability to augment and enhance existing Continue to show timeline reduction for time-critical targeting impact of aut capability to image analysts and decision-makers in the experimental Air Op | multiple sensor contributions from radar ed exploitation. Initiate developing tools ATR research and development computer on enhancements. Improve processing (R&D) sensor data. Develop an integrated ATR and sensor fusion technologies. 5 R&D and operational data sets. tomated multi-sensor ATR and fusion | | | |
| (U) | In FY 2005: Continue to assess the performance of Air Force and DARPA in fusion algorithms using the Air Force ATR evaluation test facility for applic | multi-sensor automatic target recognition | | | |
| | surveillance, reconnaissance, strike, and weapon systems. Continue character contributions from radar and EO (including hyperspectral imaging) sensors | erizing both single and multiple sensor | | | |
| Pr | | ing List - Item No. 17-12 of 17-15 | | Exhibit R-2a (F | PE 0603203E) |
| | | 300 | | | - 00002001 / |

| Exhibit R-2a, RDT&E | Project Justification | DA | DATE February 2004 | | |
|---|--|-----------|--|--------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors | 69DF Targ | PROJECT NUMBER AND TITLE 69DF Target Attack and Recognition Technology | | |
| data collection planning for transition (database development and up R&D computer and networking infrastructure via software, hardwar Continue improving processing capabilities and the expansion of the | re, and network integration enhancements. e DoD-wide repository for research and | | | | |
| development (R&D) sensor data. Continue developing an integrated accelerate the transition of ATR and sensor fusion technologies. Co capability to augment and enhance existing R&D and operational da | ontinue developing synthetic data generation ata sets. Continue to show impact of automated | | | | |
| multi-sensor automatic target recognition and fusion capability in ter targeting to image analysts and decision-makers in the experimental (U) | Air Operations Centers. | | | | |
| (U) MAJOR THRUST: Develop technology to detect, identify, and eng (U) In FY 2003: Characterized performance of foliage penetration radar detection and tracking with low probability of false alarms. Develop battlefield tools for improved tracking, detection, sensor managemen Developed tools for multi-intelligence georegistration. Performed e systems, providing measures of effectiveness that encompass the ent simulations to identify system integration issues, human decision fur integration plans with warfighter-selected operational systems. Test georegistration, and concepts of employment. | r sensors and algorithms for robust target ped TUT-specific intelligence preparation of the nt, and target identification and location. end-to-end modeling for the TUT family of tire kill chain cycle. Performed virtual nctions, and system processes. Developed | 12.201 | 4.979 | 0.000 | |
| (U) In FY 2004: Demonstrate TUT-specific intelligence preparation of the detection, sensor management, and target identification and location georegistration with fusion architecture. Finish system functionality and perform study of possible trades in concepts of employment. (U) In EX 2005: Not Appliable, Work completed | a. Integrate tools for multi-intelligence | | | | |
| (U) In FY 2005: Not Applicable. Work completed.(U) | | | | | |
| (U) MAJOR THRUST: Develop and demonstrate a moderate confidenc cueing (ATR/C) capability for stationary and moving targets. | ce automatic target recognition and advanced | 8.900 | 0.000 | 2.087 | |
| (U) In FY 2003: Continued developing a follow-on, high confidence co Combat Identification for Surface Targeting effort. Characterized at determine its utility for ATR/C and combat identification. Develope management, and system performance analyses. Characterized the p multiple moving targets. Performed advanced multi-sensor data coll Determined which combination of sensors, modes, and fusion proce identification of the highest confidence. | dvanced stationary and moving target radar data to ed tools to support sensor system, sensor performance of identification techniques for lection on stationary and moving targets. essing techniques would provide combat | | | | |
| (U) In FY 2004: Not Applicable. Air Force realignment of projects due | | | | | |
| Project 69DF R- | -1 Shopping List - Item No. 17-13 of 17-15 | | Exhibit R-2a (F | PE 0603203F) | |

| | Exhibit R-2a, RDT&E Proje | DA | DATE February 2004 | | |
|------------|--|---|---|-----------------|--------------|
| | GET ACTIVITY Advanced Technology Development (ATD) | | CT NUMBER AND TITLE Target Attack and Recognitior | | |
| | Technology program provided additional funding in FY 2003, but no addi | onal funding in FY 2004. Beginning in | | | |
| (U) | FY 2005, this effort is supported by planned-for core funding. In FY 2005: Perform critical experiments based upon results from studies and sensors, modes, and fusion processing techniques would provide combat ide Perform engineering-level analyses and critical experiments to determine what techniques may provide a near-term combat identification capability of the h technology demonstration effort of promising near-term sensor technologies Continue characterization studies of advanced stationary and moving target automatic target recognition and advanced cueing (ATR/C) and combat iden support sensor system, sensor management, and system performance analyse | ntification of the highest confidence. nat sensor technologies and fusion highest confidence achievable. Initiate a and fusion processing techniques. radar data to determine its utility for tification. Refine tool development to | | | |
| | collections on stationary and moving targets. | | | | |
| (U) (U) | MAJOR THRUST: Develop and demonstrate an automatic target recognition | on (ATR) capability integrated with | 0.000 | 2.579 | 3.287 |
| | advanced geo-registration techniques and innovative change detection algorithm | thms. | | | |
| (U) | In FY 2003: Not Applicable. In FY 2004: Initiate a spiral development activity focused on time-critical ta advanced real-time contingency cell in support of initial experiments for the Perform mission-level and system-of-systems studies and analyses to determ modes, and fusion processing techniques would provide a high confidence constationary and moving ground targets. | Combined Air Operations Center. nine which combination of sensors, ombat identification capability for | | | |
| (U) (U) | In FY 2005: Integrate ATR with automatic target cueing, geo-registration, a Demonstrate initial integrated time-critical targeting capability leveraging th the Targets Under Trees program products and the technology developments Research Projects Agency Dynamic Tactical Targeting program. | e Advanced Real-Time Contingency Cell, | | | |
| | CONGRESSIONAL ADD: National Operational Signature Production and | Research Capability. | 2.024 | 5.000 | 0.000 |
| · · | In FY 2003: Continued expanding the database and began creating the signa to consistently and expediently expand database production support for critic | ature modeling and simulation capability | | | |
| | In FY 2004: Mature the signature modeling and simulation capability to cor database production support for critical combat identification systems. Expa radar signature prediction codes and tools to support a deployed non-coopera- | and and enhance the target and threat | | | |
| | In FY 2005: Not Applicable. Total Cost | | 35.105 | 21.394 | 16.303 |
| Pro | oject 69DF R-1 Shoppi | ng List - Item No. 17-14 of 17-15 | | Exhibit R-2a (I | PE 0603203F) |

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| | UNCLASSIFIED | | | |
|---|---|--------------------------|--|--|
| Exhibit R-2a, RDT& | DATE February 2004 | | | |
| BUDGET ACTIVITY 3 Advanced Technology Development (ATD) | | | | |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | | | |
| U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Project 69DF | R-1 Shopping List - Item No. 17-15 of 17-15 | Exhibit R-2a (PE 0603203 | | |

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PE NUMBER: 0603205F PE TITLE: Flight Vehicle Technology

| | Exhibit R-2, RD | T&E Budge | et Item Just | tification | | | DATE | February | 2004 |
|--|--|---------------------|---------------------|---------------------|------------------------|---------------------|---------------------|-----------------|----------------|
| UDGET ACTIVITY 3 Advanced Technology Devel | opment (ATD) | | | E NUMBER AND | TITLE ht Vehicle Te | chnology | | <u> </u> | |
| Cost (\$ in Millions | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total | |
| Total Program Element (PE) | Actual Cost 3.463 | 0.992 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | Continuing | TB |
| 398 Air Base Technology | 3.463 | 0.992 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | Continuing | TB |
| E-SMART) Chemical and Biological ircraft. (J) <u>A. Mission Description and B</u> Prior to FY 2003, this project d recovery, protective systems, ai | udget Item Justification eveloped technologies fo | r fixed and bare | | | | | | | |
| This program is in the Budget A that have military utility and ad | Activity 3, Advanced Tec dress warfighter needs. | | opment, since it | t develops and o | demonstrates te | chnologies for | exhibiting nev | v systems devel | opment |
| | | | | | | <u>FY 2003</u> | <u>FY</u> 2 | 2004 | <u>FY 2005</u> |
| J) Previous President's Budget | | | | | | 3.463 | | .000 | 0.000 |
| J) Current PBR/President's Budge | t | | | | | 3.463 | | .992 | 0.000 |
| J) Total Adjustments | | | | | | 0.000 | 0 | .992 | |
| J) Congressional Program Reducti | ions | | | | | | 0 | .008 | |
| Congressional Rescissions Congressional Increases | | | | | | | | .008 | |
| Congressional increases Reprogrammings SBIR/STTR Transfer J) <u>Significant Program Changes:</u> In FY 2003, remaining efforts t | ransferred to PE 0603112 | E Project 4019 | However Co | marace has add | led funds for sp | acial interact pr | | | |
| m i i 2005, remaining errorts t | | , i iojou +/10 | 110wever, et | Jingress has add | ice funds for spi | in increat pr | ojeets since i i | 2005. | |
| | | | | | | | | | |

| | Ext | nibit R-2a, | RDT&E Pro | ject Justif | ication | | | DATE | Echruory | 2004 |
|--|--|--|--|---------------------------|---------------------|---------------------|-----------------------------------|----------------------|---|-------------------------|
| BUDGET ACTIVITY 03 Advanced Techno | | · | | P | PE NUMBER AND | | | PROJECT NUME | February BER AND TITLE e Technology | |
| Contra | | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| Cost (| (\$ in Millions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 4398 Air Base Tech | | 3.463 | 0.992 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | Continuing | TB |
| Quantity of RI | DT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Prior to FY 2003, recovery, protectiv This program is in | iption and Budget Iten this project developed to ve systems, airfield fire the Budget Activity 3, utility and address warf | echnologies fo protection, and Advanced Tec | r fixed and bare crash rescue. | - | _ | _ | | | - | |
| U) <u>B. Accomplishmen</u> U) CONGRESSIONA monitoring system U) In FY 2003, Contir sensor and monitor | ts/Planned Program (L ADD: Develop and in (E-SMART [™]) system. nued Congressionally-din ing technologies into the s for this effort were app | \$ in Millions) ntegrate addition rected effort to e E-SMART ^{TP} | develop and in ^a system. | tegrate addition | nal chemical an | d biological | | <u>2003</u> 3.463 | <u>FY 2004</u> 0.000 | <u>FY 2005</u> 0.000 |
| U) U) CONGRESSIONA U) In FY 2003: Not A | L ADD: Conduct a stud applicable. e Congressionally-direct | | - | • | | ircraft. | | 0.000 | 0.992 | 0.000 |
| (U) Total Cost | applicable. | | | | | | | 3.463 | 0.992 | 0.000 |
| (II) C Other Program | n Funding Summary (§ | in Millions) | | | | | | | | |
| (U) Related Activities: (U) PE 0603112F, Adv Materials for Weap This project was co through the Relian harmonize efforts a duplication. | FY yanced pon Systems. pordinated ce process to | <u>2003 F</u> | | <u>Y 2005</u> Estimate | FY 2006 Estimate | FY 2007 Estimate | <u>FY 2008</u> <u>Estimate</u> | FY 2009 Estimate | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| Project 4398 | | | R-1 Sh | nopping List - Iter | m No. 18-3 of 18- | 4 | | | Exhibit R-2a (| PE 0603205F) |
| | | | | 306 | | | | | L(1) | |

| Exhibit R-2a, RDT | DATE Febr | uary 2004 | |
|---|---|--|----------------------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603205F Flight Vehicle Technology | PROJECT NUMBER AND 4398 Air Base Tech | nology |
| (U) <u>D. Acquisition Strategy</u> | | | |
| Not Applicable. | | | |
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| Project 4398 | R-1 Shopping List - Item No. 18-4 of 18-4 | Exhibi | t R-2a (PE 0603205F) |

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PE NUMBER: 0603211F PE TITLE: Aerospace Technology Dev/Demo

| | Exhibit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | DATE February 2004 | | |
|---|--|---------------------|-------------------------------------|--------------------------------|---------------------|--------------------------|---------------------|-----------------------|--------------------------|--|
| BUDGET ACTIVITY D3 Advanced Technology Develop | ment (ATD) | | | E NUMBER AND | | nology Dev/D |)emo | rebruary | 2004 | |
| Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total | |
| Total Program Element (PE) C | | 47.610 | 29.145 | 27.199 | 26.019 | 29.009 | 30.500 | Continuing | TI | |
| 486U Advanced Aerospace Structure | | 15.535 | 3.682 | 5.847 | 5.964 | 6.064 | 6.162 | Continuing | T | |
| 4920 Flight Vehicle Tech Integration | 1 | 32.075 | 25.463 | 21.352 | 20.055 | 22.945 | 24.338 | Continuing | T | |
| 5099 National Aerospace Initiative | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | Continuing | T | |
| added \$6.2 million for advanced a million for fly-by-light avionics fo vehicle. This program is in the Budget Act upgrades and/or new system devel | or unmanned combat air ivity 3, Advanced Tech | vehicle (UCA | V), \$0.9 millio pment, since it | n for MEDLIN develops and c | IK global respo | nse, and \$3.4 m | nillion for sense | orcraft unmann | ed aerial | |
| U) <u>B. Program Change Summary (S</u> | <u>s in Millions)</u> | | | | | EV 2002 | EV | 2004 | EV 2005 | |
| U) Previous President's Budget | | | | | | <u>FY 2003</u> 29.002 | <u>FY 2</u> 73 | .416 | <u>FY 2005</u> 31.427 | |
| U) Current PBR/President's Budget | | | | | | 27.767 | | .610 | 29.145 | |
| U) Total Adjustments | | | | | | -1.235 | | .806 | 27.113 | |
| U) Congressional Program Reduction | s | | | | | | | .298 | | |
| Congressional Rescissions | | | | | | | | .408 | | |
| Congressional Increases | | | | | | | 16 | .900 | | |
| Reprogrammings | | | | | | -0.408 | | | | |
| SBIR/STTR Transfer | | | | | | -0.827 | | | | |
| U) <u>Significant Program Changes:</u> Changes to this program since the | previous President's Bu | idget are due to | higher Air Fo | rce priorities. | | | | | | |
| | | | | | | | | | | |
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| | Ex | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DA | TE February | 2004 |
|---|--|---|---|---|--|---|--|--|--|------------------------------|
| | ET ACTIVITY dvanced Technology Development | (ATD) | | 0 | PE NUMBER AND 1603211F Aer 1900/Demo | | nology | | IMBER AND TITLE | ce Structures |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | | |
| 486U | | 8.687 | 15.535 | 3.682 | 5.847 | 5.964 | 6.064 | | U | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | |
| | A. Mission Description and Budget Iter This project develops and demonstrates a capability of current and future aerospace lead to reduced operations and support co allowing and certifying new designs under increase survivability in high threat envir reduce the life cycle costs of fielded aircr | ffordable aerosp e vehicles. Susta osts, and increase er reduced test re conments. Demo | inment of the ed operational a | existing fleet th readiness. Ana Development of | nrough extended alytical certifica f capability enh | d operational so ation will reduc ancing technologi | ervice life with e the cost asso ogies will expa | n innovative to ociated with c and the operation | echnology applica component replace tional envelope ar | ation will ement by nd |
| (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 | B. Accomplishments/Planned Program MAJOR THRUST: Develop technologies in FY 2003: Continued improvements in a vehicle structures for reduced operations a development of technology required for fu- structures. Continued development of new capabilities to thick and complex geometry structural components. In FY 2004: Develop improvements in su- structures for reduced operations and supp development of new analytical methods ar complex geometry structures enabling rep in FY 2005: Not Applicable. Changes to the | s to improve trad sustainment tech and support costs all implementation v analytical meth y structures enab- stainment techno- port costs and to and techniques to airs in lieu of rep | and to extend on of bonded co ods and technoling repair in 1 ologies for exist extend the usal extend bonded olacement of p | kisting aging ai usable structur omposite repair iques to expand ieu of replacen sting aging airc ble structural li composite rep rimary load car | arcraft and futur ral lives. Contin r of thick and co d bonded compo- nent of primary craft and future ves. Continue oair capability to rrying structura | e aerospace nued the omplex osite repair load carrying air vehicle the o thick and | E | <u>ř 2003</u> 1.949 | <u>FY 2004</u> 2.917 | <u>FY 2005</u> 0.000 |
| f (U) l a s i | MAJOR THRUST: Develop non-tradition for future aircraft. In FY 2003: Developed improved non-tra aircraft availability, and reduce operations structures to replace mechanically fastened n-service usage in elimination of mainten In FY 2004: Develop innovative non-trad | ditional sustainr and support cos d built up compo ance actions due | nent technolog ts. Continued onents that are a to loose faster | ies that will ex development o highly suscepti ters and fasten | tend aircraft lif of unitized comp ble to damage f er hole damage | e, increase posite from dynamic | | 2.806 | 2.406 | 0.115 |
| Proje | ect 486U | | R-1 Sh | opping List - Item | n No. 19-3 of 19-1 | 1 | | | Exhibit R-2a (| PE 0603211F) |

| Exhibit R-2a, RDT&E Project | DATE February 2004 | | | |
|--|--|-------|-----------------------------------|-------------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo | | UMBER AND TITLE anced Aerospac | e Structure |
| aircraft availability, and reduce operations and support costs. Complete developments for repair or replacement of mechanically fastened built up compone fasteners and fastner hole damage from dynamic in-service usage, thereby proactions. | ents that are highly susceptible to loose | | | |
| (U) In FY 2005: Develop innovative non-traditional sustainment technologies tha aircraft availability, and reduce operations and support costs. Develop real-tin monitoring tools of thermal protection systems, fuel tanks, structure, and subsy operations and allowing rapid turn around for high-speed vehicles. | ne diagnostic and prognostics health | | | |
| (U) (U) MAJOR THRUST: Develop and demonstrate technologies related to improve and acoustic reduction in current and future aircraft. Note: Prior to FY 2005, in the improved performance of unmanned platform thrust. | - | 0.000 | 0.000 | 3.567 |
| (U) In FY 2003: Not Applicable.(U) In FY 2004: Not Applicable. | | | | |
| (U) In FY 2004. Not Applicable. (U) In FY 2005: Develop active flow control devices to significantly increase and miniature munitions and reduce weapon bay acoustics to minimize damage at | | | | |
| (U) (U) CONGRESSIONAL ADD: Advanced Aluminum Aerostructures Initiatives (A) (U) In FY 2003: Initiated Congressionally-directed effort for advanced aluminum (U) In FY 2004: Continued Congressionally-directed effort for advanced aluminu two Congressional Adds were made for this effort; both are being managed as | a aerostructures. Im aerostructures. Note: In FY 2004, | 3.472 | 6.345 | 0.000 |
| (U) In FY 2005: Not Applicable. (U) (U) CONGRESSIONAL ADD: Composites. (U) In FY 2003: Initiated Congressionally-directed efforts for ultra-lightweight co (U) In FY 2004: Continued Congressionally-directed effort for unmanned aerial v (U) In FY 2005: Not Applicable. | - | 0.460 | 1.388 | 0.000 |
| (U) (U) CONGRESSIONAL ADD: Three-Dimensional Bias Woven Preforms Develo (U) In FY 2003: Not Applicable. No FY 2003 funds. (U) In FY 2004: Continue Congressionally-directed effort for Three-Dimensional Program begun with FY 2002 Congressional Add. | | 0.000 | 2.479 | 0.000 |
| (U) In FY 2005: Not Applicable.(U) Total Cost | | 8.687 | 15.535 | 3.682 |
| | g List - Item No. 19-4 of 19-11 | 0.007 | Exhibit R-2a (I | |

| Exhi | bit R-2a, RDT&E Pro | oject Justification | DATE Febr | DATE February 2004 | | |
|--|---------------------|--|--------------------|-----------------------|--|--|
| UDGET ACTIVITY 3 Advanced Technology Development (A | TD) | PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo | PROJECT NUMBER AND | TITLE | | |
| U) <u>C. Other Program Funding Summary (\$ i</u> | in Millions) | | | | | |
| U) D. Acquisition Strategy Not Applicable. | | | | | | |
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| Project 486U | R-1 Si | hopping List - Item No. 19-5 of 19-11 | Exhibit | : R-2a (PE 0603211F | | |

| | Ex | hibit R-2a, I | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|---|--|--|--|---|--|---|------------------|--|--|----------------|
| | ET ACTIVITY dvanced Technology Development (| (ATD) | | 0 | E NUMBER AND 603211F Aer Dev/Demo | | nology | | BER AND TITLE /ehicle Tech I | ntegration |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 4920 | Flight Vehicle Tech Integration | 19.080 | 32.075 | 25.463 | 21.352 | 20.055 | 22.945 | | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) | A. Mission Description and Budget Iter This project integrates and demonstrates a unmanned aerospace vehicles. System le demonstration in a near-realistic operation operational aircraft. This program provid | advanced flight evel integration b nal environment | orings together . Integration a | the aerospace and technology | vehicle technologies demonstrations | ogies along wit reduce the ris | th avionics, pro | opulsion, and w uired to transition | eapon systems for technologies | for into |
| (U) I | 3. Accomplishments/Planned Program (| (\$ in Millions) | | | | | F۱ | <u> 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| | MAJOR THRUST: Develop of autonomo | | s for safe fligh | t operations be | tween manned | and unmanned | | 4.484 | 13.490 | 9.482 |
| | ir platforms. | 0 | C | | | | | | | |
| i (U)] i t t (U)] i t t t t t t t t t t t t t t t t t t | n FY 2003: Developed and demonstrated nteroperable application of unmanned and algorithms for automated air collision avoid software system architecture for cooperative and algorithms for automatic air collision a in FY 2004: Develop and demonstrate key nteroperable application of unmanned veh- cuite combining compact, low-cost hardwar rajectory-generating outer-loop control to unmanned vehicle systems. Develop and de Develop automated aerial refueling algorit eliminate need for forward staging areas, e with fewer assets. In FY 2005: Continue development and de algorithms to enable the safe and interoper and test of key autonomous control compo- uutonomous control system suite to provid vehicle systems. Demonstrate key photom | I manned vehicl idance. Flight d ve control of un avoidance. y control automa nicle systems. C are with adaptive provide signific demonstrate com hms and system extend range, she emonstration of rable application onent technologi le significantly i | e systems. Con emonstrated in manned vehicle ation technique continue develo e, fault tolerant cantly increased trol componen design concep orten response control automa of unmanned es. Demonstra ncreased reliab | ntinued develop telligent-agent es. Continued of s and algorithm opment of an in inner-loop cor d reliability and t technologies to ts for unmanne time, and enab ation technique vehicle system te fully integra ility and missio | pment of hardw based algorithm demonstration of ns to enable the tegrated contro- ntrol and autom l mission effect for systems inte ed and manned le in-theater for es, components, s. Complete th ted, adaptive, fron on effectiveness | vare and ms and modula of hardware e safe and al technology omous, tiveness for egration. systems to rece projection and e integration ault tolerant, | | | | |
| (U) (U) 1 | MAJOR THRUST: Develop an Automated | d Aerial Refueli | ng canability fo | or unmanned a | nd manned air 1 | platforms. | | 0.000 | 0.000 | 5.167 |
| | ect 4920 | | • • • | | - | • | | 0.000 | Exhibit R-2a (I | |
| FIUJE | UL 432U | | K-1 20 | | n No. 19-6 of 19-1 | 11 | | | | -L 0003211F) |

| BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND TITLE 03 Advanced Technology Development (ATD) PE NUMBER AND TITLE 420 Flight Vehicle Tech Integ 04 Odvanced Technology Development (ATD) PE NUMBER AND TITLE 420 Flight Vehicle Tech Integ 05 03 211F Aerospace Technology Pervice Technology 420 Flight Vehicle Tech Integ 05 003: Not Applicable. (1) In FY 2003: Not Applicable. (2) In FY 2005: Complete development of automated aerial refueling sensing, communication, and control algorithm components. Complete integration, simulation, and analysis verifying safe autonomous operation in proximity of maaned tankers. Begin flight demonstrations of initial automated aerial refueling capability for unmanned aerial vehicles using existing fleet tankers, operational procedures, and unmanned combat air vehicles. 3.716 2.863 (U) In FY 2003: Develop and demonstrate integrated technologies to improve the performance of unmanned arial vehicle systems. Complete baseline systems architecture combining compact, low-cost hardware with adaptive, fault tolerant inner-loop control ad autonomous, trajectory-generating outer-loop control. Develope advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformat integrated installed propulsion system performance at reduced weight and size. Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate anactively control devices to increase and enhance th | | Exhibit R-2a, RDT&E Project | Justification | DATE February 2004 | | | |
|--|------|---|--|-----------------------|---------------------|-------------|--|
| increased visibility for this effort. (U) In FY 2003: Not Applicable. (U) In FY 2005: Complete development of automated aerial refueling sensing, communication, and control algorithm components. Complete integration, simulation, and analysis verifying safe autonomous operation in proximity of manned tankers. Begin flight demonstrations of initial automated aerial refueling capability for unmanned aerial vehicles. (U) In FY 2005: Develop and demonstrate integrated technologies to improve the performance of unmanned arial platforms. (U) In FY 2003: Developed an integrated control technology suite to provide increased reliability and mission effectiveness for unmanned vehicle systems. Completed baseline systems architecture combining compact, low-cost hardware with adaptive, fault tolerant inner-loop control and autonomous, trajectory-generating outer-loop control. Developed, tested, and verified component technologies for systems increased. (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system enabling increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate active flow control devices to increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion s | | | 0603211F Aerospace Technology | | CT NUMBER AND TITLE | | |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Not Applicable. (U) In FY 2005: Complete development of automated aerial refueling sensing, communication, and control algorithm components. Complete integration, simulation, and analysis verifying safe autonomous operation in proximity of manned tankers. Begin flight demonstrations of initial automated aerial refueling capability for unmanned aerial vehicles using existing fleet tankers, operational procedures, and unmanned combat air vehicles. (U) MAJOR THRUST: Develop and demonstrate integrated technologies to improve the performance of unmanned 3.716 2.863 (U) MAJOR THRUST: Developed an integrated control technology suite to provide increased reliability and mission effectiveness for unmanned vehicle systems. Complete baseline systems architecture combining compact, low-cost hardware with adaptive, fault tolerant inner-loop control and autonomous, trajectory-generating outer-loop control. Developed, tested, and verified component technologies for systems integration. (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system onabling increased installed propulsion system performance at reduced weight and size. Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration envelope for miniature munitions and reduce weapon bay acoustics to increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for | | • | rust area were broken out to allow for | | | | |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Complete development of automated aerial refueling sensing, communication, and control algorithm components. Complete integration, simulation, and analysis verifying safe autonomous operation in proximity of manned tarkers. Begin flight demonstrations of initial automated aerial refueling capability for unmanned aerial vehicles using existing fleet tankers, operational procedures, and unmanned combat air vehicles. (U) (U) MAJOR THRUST: Develop and demonstrate integrated technologies to improve the performance of unmanned aerial vehicles are with adaptive, fault tolerant inner loop control and automatous, trajectory-generating outer-loop control. Developed an evelicle systems. Completed baseline systems architecture combining compact, low-cost hardware with adaptive, fault tolerant inner-loop control and automomous, trajectory-generating outer-loop control. Developed, tested, and verified component technologies for systems integration. (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system control devices to increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem certormance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled c | аn | • | | | | | |
| (U) In FY 2005: Complete development of automated aerial refueling sensing, communication, and control algorithm components. Complete integration, simulation, and analysis verifying safe autonomous operation in proximity of manned tankers. Begin flight demonstrations of initial automated aerial refueling capability for unmanned aerial vehicles using existing fleet tankers, operational procedures, and unmanned combat air vehicles. (U) MAJOR THRUST: Develop and demonstrate integrated technologies to improve the performance of unmanned platforms. (U) In FY 2003: Developed an integrated control technology suite to provide increased reliability and mission effectiveness for unmanned vehicle systems. Completed baseline systems architecture combining compact, low-cost hardware with adaptive, fault tolerant inner-loop control and autonomous, trajectory-generating outer-loop control. Developed, tested, and verified component technologies for systems integration. (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system enabling increased installed propulsion system performance at reduced weight and size. Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance a | | | | | | | |
| components. Complete integration, simulation, and analysis verifying safe autonomous operation in proximity of manned tankers. Begin flight demonstrations of initial automated aerial refueling capability for unmanned aerial vehicles using existing fleet tankers, operational procedures, and unmanned combat air vehicles. (U) (U) MAJOR THRUST: Develop and demonstrate integrated technologies to improve the performance of unmanned platforms. (U) In FY 2003: Developed an integrated control technology suite to provide increased reliability and mission effectiveness for unmanned vehicle systems. Completed baseline systems architecture combining compact, low-cost hardware with adaptive, fault tolerant inner-loop control and autonomous, trajectory-generating outer-loop control. Developed, tested, and verified component technologies for systems integration. (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal intel system of enabling increased and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced weight and size. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced weight and size.<!--</td--><td></td><td>**</td><td>munication, and control algorithm</td><td></td><td></td><td></td> | | ** | munication, and control algorithm | | | | |
| manned tankers. Begin flight demonstrations of initial automated aerial refueling capability for unmanned aerial vehicles using existing fleet tankers, operational procedures, and unmanned combat air vehicles. (U) MAJOR THRUST: Develop and demonstrate integrated technologies to improve the performance of unmanned aerial platforms. (U) In FY 2003: Developed an integrated control technology suite to provide increased reliability and mission effectiveness for unmanned vehicle systems. Completed baseline systems architecture combining compact, low-cost hardware with adaptive, fault tolerant inner-loop control and autonomous, trajectory-generating outer-loop control. Developed, tested, and verified component technologies for systems integration. (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increase dystem performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. (U) MAJOR THRUST: Develop analytical certification methods and c | ` ´ | | | | | | |
| vehicles using existing fleet tankers, operational procedures, and unmanned combat air vehicles. (U) (U) MAJOR THRUST: Develop and demonstrate integrated technologies to improve the performance of unmanned 3.716 2.863 platforms. (U) In FY 2003: Developed an integrated control technology suite to provide increased reliability and mission effectiveness for unmanned vehicle systems. Completed baseline systems architecture combining compact, low-cost hardware with adaptive, fault tolerant inner-loop control and autonomous, trajectory-generating outer-loop control. Developed, tested, and verified component technologies for systems integration. (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system enabling increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to increase and enhance the separation envelope for miniature at reduced cost. Demonstrate an actively controlled conformal inlet system of system performance at reduced weight and size. Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion syst | | | | | | | |
| (U) MAJOR THRUST: Develop and demonstrate integrated technologies to improve the performance of unmanned 3.716 2.863 (U) In FY 2003: Developed an integrated control technology suite to provide increased reliability and mission effectiveness for unmanned vehicle systems. Completed baseline systems architecture combining compact, low-cost hardware with adaptive, fault tolerant inner-loop control and autonomous, trajectory-generating outer-loop control. Developed, tested, and verified component technologies for systems integration. (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system enabling increased installed propulsion system performance at reduced weight and size. Develop and demonstrate active flow control devices to increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased system performance at reduced cost. Un In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 1.735 | | | | | | | |
| platforms. (U) In FY 2003: Developed an integrated control technology suite to provide increased reliability and mission effectiveness for unmanned vehicle systems. Completed baseline systems architecture combining compact, low-cost hardware with adaptive, fault tolerant inner-loop control and autonomous, trajectory-generating outer-loop control. Developed, tested, and verified component technologies for systems integration. (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system enabling increased installed propulsion system performance at reduced weight and size. Develop and demonstrate active flow control devices to increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. (U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 1.735 | (U) | | | | | | |
| (U) In FY 2003: Developed an integrated control technology suite to provide increased reliability and mission effectiveness for unmanned vehicle systems. Completed baseline systems architecture combining compact, low-cost hardware with adaptive, fault tolerant inner-loop control and autonomous, trajectory-generating outer-loop control. Developed, tested, and verified component technologies for systems integration. (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system enabling increased installed propulsion system performance at reduced weight and size. Develop and demonstrate active flow control devices to increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. (U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 | (U) | MAJOR THRUST: Develop and demonstrate integrated technologies to improv | ve the performance of unmanned | 3.716 | 2.863 | 3.464 | |
| effectiveness for unmanned vehicle systems. Completed baseline systems architecture combining compact, low-cost hardware with adaptive, fault tolerant inner-loop control and autonomous, trajectory-generating outer-loop control. Developed, tested, and verified component technologies for systems integration. (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system enabling increased installed propulsion system performance at reduced weight and size. Develop and demonstrate active flow control devices to increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. (U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 1.735 | | | | | | | |
| hardware with adaptive, fault tolerant inner-loop control and autonomous, trajectory-generating outer-loop control. Developed, tested, and verified component technologies for systems integration. (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system enabling increased installed propulsion system performance at reduced weight and size. Develop and demonstrate active flow control devices to increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. (U) (U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 1.735 | (U) | | • | | | | |
| Developed, tested, and verified component technologies for systems integration. (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system enabling increased installed propulsion system performance at reduced weight and size. Develop and demonstrate active flow control devices to increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. (U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 1.735 | | | | | | | |
| (U) In FY 2004: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system enabling increased installed propulsion system performance at reduced weight and size. Develop and demonstrate active flow control devices to increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced aerodynamic/structural integration concepts to enable increased system performance at reduced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance at reduced aerodynamic/structural integration concepts to enable increased propulsion system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. (U) (U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 1.735 | | | | | | | |
| at reduced cost. Continue development and producibility demonstration of system hardware for an actively controlled conformal inlet system enabling increased installed propulsion system performance at reduced weight and size. Develop and demonstrate active flow control devices to increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. (U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 1.735 | (II) | | | | | | |
| conformal inlet system enabling increased installed propulsion system performance at reduced weight and size. Develop and demonstrate active flow control devices to increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. (U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 1.735 | (0) | | · · | | | | |
| Develop and demonstrate active flow control devices to increase and enhance the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. (U) (U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 1.735 | | | • | | | | |
| munitions and reduce weapon bay acoustics to minimize damage susceptibility of sensitive commercial subsystem electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. (U) (U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 1.735 | | | | | | | |
| electronics. (U) In FY 2005: Develop advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. (U) (U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 1.735 | | | | | | | |
| at reduced cost. Demonstrate an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. (U) (U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 1.735 | | | | | | | |
| performance for unmanned air vehicles.(U) | (U) | In FY 2005: Develop advanced aerodynamic/structural integration concepts to e | enable increased system performance | | | | |
| (U)(U)(U)MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in0.4091.735 | | • • | ncreased propulsion system | | | | |
| (U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in 0.409 1.735 | | performance for unmanned air vehicles. | | | | | |
| | | | | 0.400 | 1 505 | | |
| the certification of structural components resulting in reduced acquisition cost for new systems and reduced support | (U) | | | 0.409 | 1.735 | 0.577 | |
| costs for future and legacy systems. | | | or new systems and reduced support | | | | |
| (U) In FY 2003: Demonstrated and validated advanced control mechanization technologies to provide highly reliable | an | | pologies to provide highly reliable | | | | |
| operation for manned and unmanned systems at significantly reduced size, weight, and cost. Completed advanced | (0) | | | | | | |
| development and demonstration of direct optical control and interfacing of vehicle management and more-electric | | | - | | | | |
| subsystems. Transfered technology to unmanned air vehicle control integration efforts. | | | • | | | | |
| (U) In FY 2004: Develop advanced structural concepts and design methods for future aerospace vehicle airframes for | (U) | | | | | | |
| enhanced affordability and higher performance. Complete demonstration of advanced of low-cost bonded composite | | | | | | | |
| Project 4920 R-1 Shopping List - Item No. 19-7 of 19-11 Exhibit R-2a (PE 060 | Pr | pject 4920 R-1 Shopping L | List - Item No. 19-7 of 19-11 | | Exhibit R-2a (P | E 0603211F) | |

| Exhibit R-2a, RDT&E Project Jus | tification | DA | February | 2004 |
|--|---|-------|------------------------------------|--------------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo | | MBER AND TITLE t Vehicle Tech I | |
| structures concepts enabled by new analysis, manufacturing and assembly processes costs of current and future aerospace vehicles by maximizing the use of composite s reliably use virtual and analytical methods to substantially reduce the need for physi structural components resulting in reduced acquisition cost for new systems and redu- systems. | tructures. Develop approaches to cal testing in the certification of | | | |
| (U) In FY 2005: Develop improved sustainment technologies for existing aging aircraft structures to reduce operations and support costs and extend usable structural lives. prognostics health monitoring tools of thermal protection systems, tanks, structures, turn around and high temperature operations. Complete the demonstration of approa analytical methods to substantially reduce the need for physical testing in the certific resulting in reduced acquisition cost for new systems and reduced support costs for l | Develop real-time diagnostic and and subsystems to enable rapid ches to reliably use virtual and ration of structural components | | | |
| (U)(U) MAJOR THRUST: Develop aircraft structures that have embedded components, where the structure is the structure of the s | nich have previously been | 1.909 | 4.174 | 4.175 |
| separate components that were attached to the air platforms. | | | | |
| (U) In FY 2003: Developed multi-functional integrated structures to reduce acquisition volume, while increasing the performance of air vehicles. Continued development of frequency multi-element antenna arrays in load bearing structure to enable increased capabilities at reduced cost, weight, and volume. Developed highly efficient and du with embedded electrical conductors and data cabling, health monitoring networks, thermal management to minimize vehicle weight, volume, and acquisition and support. | f concepts with embedded high antenna performance and new rable multi-function structures fuel handling and sensing, and | | | |
| (U) In FY 2004: Develop multi-functional integrated structures to reduce acquisition co volume and increase performance of air vehicles. Continue development of concept frequency multi-element antenna arrays in load bearing structure for antenna perforr vehicle weight and volume. Develop highly efficient and durable structures with en data cabling, health monitoring networks, fuel handling and sensing, and thermal ma weight, volume, and acquisition and support costs. | s with embedded high and low nance improvement and reduced bedded electrical conductors and | | | |
| (U) In FY 2005: Continue development of multi-functional integrated structures to reduce weight, and volume and increase performance of air vehicles. Complete demonstrate multi-element antenna arrays embedded in load-bearing structure to increase antenna reduced vehicle weight, cost, and volume. Continue development of concepts of very arrays embedded in load-bearing structure to enable new antenna capabilities and increase generative structure. | ion of concepts with high a performance improvement and y large, low frequency antenna | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop aircraft designs and technologies that improve the over | | 1.806 | 0.000 | 0.000 |
| | Item No. 19-8 of 19-11 | | Exhibit R-2a (F | °⊏ 0603211F) |

| Exhibit R-2a, RDT&E Pro | ject Justification | DA | DATE February 2004 | | |
|--|--|-------|-------------------------------------|-------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo | | JMBER AND TITLE t Vehicle Tech I | ntegration | |
| systems, which are embedded inside current and future aircraft. (U) In FY 2003: Developed integral airframe technologies to enable increase Successfully completed demonstration of inlet duct concepts with advance structural integration, enhanced performance, survivability, and increased conformal inlet concepts with advanced aerodynamic technologies that ensystems. (U) In FY 2004: Not Applicable. Changes to this program are due to higher | red aerodynamic technologies that enable l propulsion system performance. Developed hable higher efficiency of propulsion | | | | |
| (U) In FY 2005: Not Applicable. Changes to this program are due to higher | - | | | | |
| (U) (U) MAJOR THRUST: Develop advanced structural concept designs. (U) In FY 2003: Developed advanced structural concepts and design method performance of current and future aerospace vehicles. Continued develop concepts, and design criteria to enable low-cost unitized composite struct demonstration articles for test verification of analyses methods, design concepts. | oment of new analysis methods, design ures. Continued development of | 1.717 | 0.000 | 0.000 | |
| (U) In FY 2004: Not Applicable. Changes to this program are due to higher | Air Force priorities. | | | | |
| (U) In FY 2005: Not Applicable. Changes to this program are due to higher(U) | Air Force priorities. | | | | |
| (U) MAJOR THRUST: Develop adaptive structures to provide in-flight mod | ifications offering improved performance | 2.155 | 3.269 | 2.598 | |
| over a wide range of flight conditions and mission profiles. | | | | | |
| (U) In FY 2003: Developed affordable advanced aero-structural concepts and capabilities for future aerospace vehicles. Continued flight test demonstr authority of an active aeroelastic wing. Developed concepts for applying aerodynamic drag and electromagnetic signature for reconfigurable struct capability and versatility in a single platform. Developed highly efficient design concepts, adaptive structures, and aerodynamic flow control techn long-range air vehicles and long-endurance vehicles. | ation of the increased high-speed control continuous moldline technologies to reduce tures to enable maximum warfighting twing concepts integrating active aeroelastic ologies to enable new capabilities for | | | | |
| (U) In FY 2004: Develop advanced aero-structural concepts and design meth performance, and survivability for future aerospace vehicles. Complete f control authority enable by an active aeroelastic wing. Complete demons moldline structure concepts to reduce aerodynamic drag and electromagn as mission requirements change and thus maximize its versatility. Contir concepts integrating active aeroelastic design concepts, adaptive structure technologies to enable viable long-range and long-endurance air vehicle of the FY 2005. Develop integrated thermal sinforme structure including the structure of the s | light test demonstrating increased high-speed stration of reconfigurable continuous etic signature to enable platform adaptation nue development of highly efficient wing es, and aerodynamic flow control concepts | | | | |
| (U) In FY 2005: Develop integrated thermal airframe structures, including the Project 4920 | | | Exhibit D 20 (| | |
| Project 4920 R-1 Sh | opping List - Item No. 19-9 of 19-11 316 | | Exhibit R-2a (F | = 0003211F) | |

| | Exhibit R- | -2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|--|--------------------|----------------------------|-----------------------------------|---------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|--------------|
| BUDGET ACTIVITY 03 Advanced Technology Develop | oment (ATD) | | | PE NUMBER A 0603211F A Dev/Demo | ND TITLE erospace Tec | hnology | | BER AND TITLE | |
| joining technologies, hot primary s | tructure, and stru | ctural health mo | nitoring for high | n speed vehicle a | pplications. | | • | | |
| (U) (U) CONGRESSIONAL ADD: Sensor (U) In FY 2003: Initiated Congression (U) In FY 2004: Continued Congression (U) In FY 2005: Not Applicable. | ally-directed effo | | | | | | 2.884 | 3.470 | 0.000 |
| (U) (U) CONGRESSIONAL ADD: Fly-by- (U) In FY 2003: Not Applicable. (U) In FY 2004: Initiate Congressional (UCAV). | - | | | | at Air Vehicle | | 0.000 | 2.082 | 0.000 |
| (U) In FY 2005: Not Applicable. (U) (U) Congressional Add: Medlink Glob (U) In FY 2003: Not Applicable. (U) In FY 2004: Initiate Congressional | lly-directed effor | | | s in-flight teleme | edicine access to | , | 0.000 | 0.992 | 0.000 |
| emergency physicians for assistanc(U) In FY 2005: Not Applicable.(U) Total Cost | e in managing in | -flight medical e | emergencies. | | | | 19.080 | 32.075 | 25.463 |
| (U) <u>C. Other Program Funding Sum</u> | mary (\$ in Milli | <u>ons)</u> | | | | | | | |
| | FY 2003 Actual | <u>FY 2004</u> Estimate | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | Total Cost |
| (U) Related Activities: PE 0602201F, Aerospace Vehicle Technologies. PE 0603333F, Unmanned Air Vehicle Dev/Demo. PE 0604731F, Unmanned Combat Air Vehicle. PE 0604105F, Next Generation Bomber. (U) This project has been coordinated through the | | | | | | | | | |
| Project 4920 | | P | 1 Shopping List - | Itom No. 10.10 of | 10 11 | | | Evhibit D. Oo | PE 0603211F) |

| | | DATE |
|---|--|--|
| | E Project Justification | February 2004 |
| BUDGET ACTIVITY 33 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo | PROJECT NUMBER AND TITLE 4920 Flight Vehicle Tech Integration |
| U) C. Other Program Funding Summary (\$ in Millions) Reliance process to harmonize efforts and eliminate duplication. U) D. Acquisition Strategy Not Applicable. | | |
| Project 4920 | R-1 Shopping List - Item No. 19-11 of 19-11 | Exhibit R-2a (PE 06032111 |

PE NUMBER: 0603216F PE TITLE: Aerospace Propulsion and Power Technology

| | Exhit | oit R-2, RDT | Se Budge | t Item Just | ification | | | DATE | February | 2004 |
|------|---|-------------------|---------------------|---------------------|-----------------------------|---------------------|---------------------|---------------------|---------------------|-------|
| | r activity vanced Technology Development (| ATD) | | | E NUMBER AND 603216F Aer | | ulsion and Po | ower Techno | logy | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| | Total Program Element (PE) Cost | 84.067 | 93.425 | 79.914 | 68.626 | 74.950 | 92.472 | 93.006 | Continuing | TBI |
| 2480 | Aerospace Fuels and Atmospheric Propulsion | 11.498 | 3.101 | 0.374 | 0.338 | 3.163 | 5.359 | 5.445 | Continuing | TBI |
| 3035 | Aerospace Power Technology | 5.728 | 4.185 | 4.297 | 4.332 | 4.412 | 4.487 | 4.560 | Continuing | TBI |
| 4921 | Aircraft Propulsion Subsystems Int | 33.809 | 28.600 | 16.719 | 19.647 | 15.036 | 26.533 | 26.920 | Continuing | TBL |
| 4922 | Space & Missile Rocket Propulsion | 1.344 | 12.739 | 6.039 | 7.065 | 5.038 | 5.123 | 5.204 | Continuing | TBD |
| 5098 | Advanced Aerospace Propulsion | 0.000 | 15.750 | 26.300 | 10.819 | 20.387 | 23.605 | 23.074 | Continuing | TBL |
| 681B | Advanced Turbine Engine Gas Generator | 31.688 | 29.050 | 26.185 | 26.425 | 26.914 | 27.365 | 27.803 | Continuing | TBI |

Note: In FY 2003, space unique tasks in Project 4922 were transferred to PE 0603500F, Project 5033, in conjunction with the Space Commission recommendation to consolidate all space unique activities. In Project 4922, space unique includes all Integrated High Payoff Rocket Propulsion Technology activities except Technology for the Sustainment of Strategic Systems and tactical missiles. In FY 2004, Project 5098 is a new project, but not a New Start.

(U) <u>A. Mission Description and Budget Item Justification</u>

This program develops and demonstrates technologies to achieve enabling and revolutionary advances in turbine, advanced cycle, and rocket propulsion, as well as power generation and storage, and fuels. The program has six projects, each focusing on technologies with a high potential to enhance the performance of existing and future Air Force weapons systems. The Aerospace Fuels and Atmospheric Propulsion project develops and demonstrates improved hydrocarbon fuels and advanced propulsion systems for high-speed/hypersonic flight. The Aerospace Power Technologies project develops and demonstrates power technologies for weapons and aircraft. The Advanced Turbine Engine Gas Generator (ATEGG) project develops and demonstrates core turbine engine technologies for current and future aircraft propulsion systems. The Aerospace Propulsion project integrates the engine cores demonstrated in the ATEGG project with low-pressure components into demonstrator engines. Turbine engine propulsion projects within this program are part of the Integrated High Performance Turbine Engine Technology readiness level appropriate for in-flight demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques. Rocket propulsion projects within this program are part of the Integrated High Payoff Rocket Propulsion projects within this collegies, propellants, and manufacturing technology for the Sustainment of Strategic Systems. In FY 2004, Congress added \$2.5 million for the Advanced Turbine Engine Gas Generator and Aircraft Propulsion Subsystems Integration, and removed \$23.0 million from the Space and Missile Rocket Propulsion form the Space and Missile Rocket Propulsion efforts.

R-1 Shopping List - Item No. 20-1 of 20-20

| Exhibit R-2, RDT&E B | udget Item Justification | DATE Februa | ry 2004 |
|---|---|----------------|---------|
| UDGET ACTIVITY 3 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Po | wer Technology | • |
| J) <u>B. Program Change Summary (\$ in Millions)</u> | | | |
| | <u>FY 2003</u> | <u>FY 2004</u> | FY 2005 |
| J) Previous President's Budget | 88.236 | 114.726 | 62.57 |
| J) Current PBR/President's Budget | 84.067 | 93.425 | 79.91 |
| J) Total Adjustments | -4.169 | -21.301 | |
| J) Congressional Program Reductions | | -23.000 | |
| Congressional Rescissions | | -0.801 | |
| Congressional Increases | | 2.500 | |
| Reprogrammings | -1.565 | | |
| SBIR/STTR Transfer Significant Program Changes: | -2.604 | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

R-1 Shopping List - Item No. 20-2 of 20-20

| | Exi | hibit R-2a, F | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|---|--|--|--|--|--|--|--|---|--|-----------------------------------|
| | ET ACTIVITY dvanced Technology Development (| (ATD) | | c | PE NUMBER AND 0603216F Aer Power Techno | ospace Prop | ulsion and | PROJECT NUM 2480 Aerosp Atmospheric | ace Fuels and | d |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| 2480 | Aerospace Fuels and Atmospheric Propulsion | 11.498 | 3.101 | 0.374 | 0.338 | 3.163 | 5.359 | | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | This project develops and demonstrates in flight. The advanced fuel emphasis is on turbine engine, turbine-based combined c minimize cost, reduce maintenance, and i cycle, ramjet, and scramjet engines. This | developing and ycle engines, an mprove perform project is integ | demonstrating d other advance nance of future | g new thermally ced propulsion aerospace syst | v stable, high-he systems. The p tems. The adva | eat sink, and co project also dev nced propulsio | ntrolled chem elops and dem n emphasis is ne program. | ically reacting f nonstrates fuel s on demonstratir | uels for a conve ystem compone ng concepts for | entional ents that combined |
| | B. Accomplishments/Planned Program (MAJOR THRUST: Evaluate and develop | | at/commit) or | d combined or | vala angina anti | one for novi | <u>F</u> | <u>Y 2003</u> 4.473 | <u>FY 2004</u> 0.000 | <u>FY 2005</u> 0.000 |
| (U)] (U)] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | generation aerospace vehicles and their we activities will be moved to PE 06032163F, In FY 2003: Completed development of h as gas turbine and ramjet/scramjet combina- ong-range strike. Completed evaluation of generation aerospace vehicles and their we naximize the use of vehicle speed in force ow-observables. Conducted analyses and gas turbine engine and ramjet/scramjet eng Conducted a pre-design study to evaluate f number achievable for next generation aero In FY 2004: Not Applicable. | apons for long- Project 5098. igh fidelity anal ations, for next f advanced (ran apons for long- miniaturization experiments to tine cycles, and force-multiplier | range strike an ytical tools to generation aero njet/scramjet) a range strike. It and platform optimize comp to optimize the and bomber su | d low-observal evaluate combi ospace vehicles and combined o Developed key survivability fo ponent technolo e cruise speed o urvivability as a | bles. Note: In l and cycle engine and their weap cycle engine opt engine technolo or a capability b ogies for transit of ramjet/scram | FY 2004, these ne options, such oons for tions for next ogies to eyond ion between jet engines. | | | | |
| | In FY 2005: Not Applicable. | | | | | | | | | |
| t t | MAJOR THRUST: Demonstrate thermall capacity (performance), minimize fuel cok funding shifts, the FY 2004-2005 high hea n post FY 2007. | ing, and reduce | fuel system m | aintenance. No | ote: Due to FY | 2005-2007 | | 0.672 | 0.802 | 0.060 |
| (U) I | In FY 2003: Studied, tested, and demonstr | rated specific ad | vanced high-h | eat sink fuels t | hat can increase | e fuel delivery | | | | |
| Proje | ect 2480 | | R-1 Sh | opping List - Iten | n No. 20-3 of 20-2 | 20 | | | Exhibit R-2a (I | PE 0603216F) |

| BUDGET ACTIVITY PE NUMBER AND TITLE PECAUGET AUMEER AND TITLE 03 Advanced Technology Development (ATD) PEGAUST FARTONICS PEGAUST FARTONICS PEGAUST FARTONICS 05 3 Advanced Technology Development (ATD) PEGAUST FARTONICS PEGAUST FARTONICS PEGAUST FARTONICS 05 3 Advanced Technology Personstrated long-term JP-84:225 performance in a fact leasystem simulators. III FY 2004: Continue to study, test, and demonstrate, at a pilot-light level, advanced high-heat sink foels and hardware concepts that can increase fuel delivery system durability and performance in a high temperatures and can roduce maintenance due to fuel desystems. Initiate demonstrate, at a pilot-light level, advanced high heat sink fuels and hardware concepts that can increase fuel delivery system durability and performance a tight femperatures and reduce maintenance due to fuel degraduation in an arrouff fuel system simulators. 0.384 0.415 0.150 (U) IN FY 2005: Continue to study, test, and demonstrate, at a pilot-light level, advanced in the performance in the heads of evolving manod systems and unmanned sections and manotex system simulators. 0.384 0.415 0.150 (U) IN ADR THRUST: Determine fuel cooling requirements and specifications for advanced arrant sensors and unmaned systems soutain high altitude bier for extended periods. Commence of fing the design and building an UAV fuel system substant high altitude loiter for extended periods. Commence of fing the design and building an UAV fuel system substasting high temperature additives for use in jet fuel | | Exhibit R-2a, RDT&E Project Just | tification | | DATE February 20 | 004 |
|---|------------|---|---|--------------------------------|---------------------|-----------|
| fiel/air heat exchanger. Demonstrated long-term JP-81-225 performance in a fuel system simulator. (U) In FY 2004: Continue to study, test, and demonstrate, at a pilot-light level, advanced high-heat sink fuels and hardware concepts that can increase fuel delivery system durability and performance at high temperatures and can reduce maintenance due to fuel degradation in aircraft fuel systems and engine control hardware. Develop bread-board, on-engine fuel additive injection hardware. Continue demonstratie, at a pilot-light level, advanced high heat sink fuels and hardware concepts that can increase fuel delivery system durability and performance at high temperatures and reduce maintenance due to fuel degradation in aircraft fuel system and engine control hardware. (U) In FY 2005: Continue to study, test, and demonstrate, at a pilot-light level, advanced high heat sink fuels and hardware concepts that can increase fuel delivery system durability and performance at high temperatures and reduce maintenance due to fuel degradation in an aircraft fuel system and unmanned aerial vehicle (UAVs). Note: Due to FY 2005: 2007 funding shifts, the FY 2004-2005 UAV fuel additive efforts were revised for a restart in post FY 2007. 0.384 0.415 0.150 (U) In FY 2003: Developed requirements for low temperature additives for use in jet fuel to allow advanced manned and unmanned systems sustain high altitude loiter for extended periods. Commenced refining the design and building an UAV fuel system/tank simulator to study high and low temperature fuel behavior. 0.384 0.415 0.150 (U) In FY 2005: Continue pilot-light level, low temperature additives for use in jet fuel to allow advanced manneed and unmanneed systems insulta | | | 0603216F Aerospace Propulsion and | n and 2480 Aerospace Fuels and | | |
| directed energy weapons that will meet the needs of evolving manned systems and unmanned aerial vehicle (UAVs). Note: Due to FY 2005-2007 funding shifts, the FY 2004-2005 UAV fuel additive efforts were revised for a restart in post FY 2007. (U) In FY 2003: Developed requirements for low temperature additives to prevent fuel from freezing to allow advanced manned and unmanned systems sustain high altitude loiter for extended periods. Commenced refining the design and building an UAV fuel system/tank simulator to study high and low temperature fuel behavior. (U) In FY 2004: Demonstrate, at a pilot-light level, low temperature additives for use in jet fuel to allow advanced manned and unmanned systems to sustain high altitude loiter for extended periods. Continue refining the design and building an UAV fuel system/tank simulator to study low temperature fuel behavior. (U) In FY 2005: Continue pilot-light level demonstrations of low temperature additives for use in jet fuel to allow advanced manned and unmanned systems to sustain high altitude loiter for extended periods with focus on combustion performance of additized fuels. (U) WAJOR THRUST: Develop and demonstrate efficacy of low-cost, environmentally friendly fuel additives to reduce so the prior. Note: Due to FY 2005.2007 funding shifts, the FY 2005 combined cycle engine fuel additive efforts were revised for a restart in post FY 2007. 0.769 0.802 0.060 (U) In FY 2003: Expanded demonstration testing with low-cost fuel additives to reduce particulate emissions from gas turbine engines using advanced research combustori and small turbine engines. Note: Due to FY 2007. 0.769 0.802 <th>(U) (U)</th> <th>fuel/air heat exchanger. Demonstrated long-term JP-8+225 performance in a fuel syst In FY 2004: Continue to study, test, and demonstrate, at a pilot-light level, advanced hardware concepts that can increase fuel delivery system durability and performance reduce maintenance due to fuel degradation in aircraft fuel systems and engine control bread-board, on-engine fuel additive injection hardware. Continue demonstrating lor bench and full-scale fuel systems. Initiate demonstration of the performance of fuel of (non-petroleum) sources in reduced scale fuel system simulators. In FY 2005: Continue to study, test, and demonstrate, at a pilot-light level, advanced hardware concepts that can increase fuel delivery system durability and performance maintenance due to fuel degradation in an aircraft fuel system and engine control hardware</th> <th>stem simulator. I high-heat sink fuels and at high temperatures and can ol hardware. Develop ng-term JP-8+225 performance in developed from alternative I high heat sink fuels and at high temperatures and reduce dware.</th> <th></th> <th></th> <th></th> | (U) (U) | fuel/air heat exchanger. Demonstrated long-term JP-8+225 performance in a fuel syst In FY 2004: Continue to study, test, and demonstrate, at a pilot-light level, advanced hardware concepts that can increase fuel delivery system durability and performance reduce maintenance due to fuel degradation in aircraft fuel systems and engine control bread-board, on-engine fuel additive injection hardware. Continue demonstrating lor bench and full-scale fuel systems. Initiate demonstration of the performance of fuel of (non-petroleum) sources in reduced scale fuel system simulators. In FY 2005: Continue to study, test, and demonstrate, at a pilot-light level, advanced hardware concepts that can increase fuel delivery system durability and performance maintenance due to fuel degradation in an aircraft fuel system and engine control hardware | stem simulator. I high-heat sink fuels and at high temperatures and can ol hardware. Develop ng-term JP-8+225 performance in developed from alternative I high heat sink fuels and at high temperatures and reduce dware. | | | |
| performance in aircraft like fuel system simulator. (U) In FY 2005: Continue pilot-light level demonstrations of low temperature additives for use in jet fuel to allow advanced manned and unmanned systems to sustain high altitude loiter for extended periods with focus on combustion performance of additized fuels. (U) (U) MAJOR THRUST: Develop and demonstrate efficacy of low-cost, environmentally friendly fuel additives to reduce 0.769 0.802 0.060 soot particulate emissions from gas turbine engines using advanced research combustors and small turbine engines. Note: Due to FY 2005-2007 funding shifts, the FY 2005 combined cycle engine fuel additive efforts were revised for a restart in post FY 2007. (U) In FY 2003: Expanded demonstration testing with low-cost fuel additives to reduce particulate emissions from gas turbine engines. Demonstrated effectiveness of particulate mitigation | (U) | directed energy weapons that will meet the needs of evolving manned systems and un Note: Due to FY 2005-2007 funding shifts, the FY 2004-2005 UAV fuel additive eff post FY 2007. In FY 2003: Developed requirements for low temperature additives to prevent fuel fur manned and unmanned systems sustain high altitude loiter for extended periods. Cor building an UAV fuel system/tank simulator to study high and low temperature fuel to In FY 2004: Demonstrate, at a pilot-light level, low temperature additives for use in manned and unmanned systems to sustain high altitude loiter for extended periods. Cor | nmanned aerial vehicle (UAVs). forts were revised for a restart in rom freezing to allow advanced nmenced refining the design and behavior. jet fuel to allow advanced Continue refining the design and | 0.384 | 0.415 | 0.150 |
| (U) MAJOR THRUST: Develop and demonstrate efficacy of low-cost, environmentally friendly fuel additives to reduce 0.769 (U) MAJOR THRUST: Develop and demonstrate efficacy of low-cost, environmentally friendly fuel additives to reduce engines. Note: Due to FY 2005-2007 funding shifts, the FY 2005 combined cycle engine fuel additive efforts were revised for a restart in post FY 2007. (U) In FY 2003: Expanded demonstration testing with low-cost fuel additives to reduce particulate emissions from gas turbine engines by 50 percent and to improve ignition characteristics and combustion in current and advanced propulsion concepts, including combined cycle engines. Demonstrated effectiveness of particulate mitigation | | In FY 2005: Continue pilot-light level demonstrations of low temperature additives f advanced manned and unmanned systems to sustain high altitude loiter for extended p | | | | |
| | (U) | soot particulate emissions from gas turbine engines using advanced research combust Note: Due to FY 2005-2007 funding shifts, the FY 2005 combined cycle engine fuel a restart in post FY 2007. In FY 2003: Expanded demonstration testing with low-cost fuel additives to reduce p turbine engines by 50 percent and to improve ignition characteristics and combustion | tors and small turbine engines. additive efforts were revised for particulate emissions from gas in current and advanced | 0.769 | 0.802 | 0.060 |
| | Pro | | | | Exhibit R-2a (PE | 0603216F) |

| Exhibit R-2a, RDT&E Project Justifica | tion | | DATE February 20 | 04 |
|---|---|--------|--|-----------|
| 03 Advanced Technology Development (ATD) 0603 | UMBER AND TITLE 3216F Aerospace Propulsion and er Technology | 2480 A | TNUMBER AND TITLE erospace Fuels and oheric Propulsion | |
| additives in a full-scale engine test. (U) In FY 2004: Continue pilot-light level demonstrations of additives that reduce soot emission Continue developing additives to improve ignition and combustion characteristics in curren concepts, including combined cycle engines. Qualify additives through material compatibil section tests, and demonstrate additive effectiveness in engine component tests. (U) In FY 2005: Continue pilot-light level demonstrations of additives that reduce soot emission (U) (U) MAJOR THRUST: Develop and demonstrate enhancements to fuel system technology. Not funding shifts, the FY 2005 combined cycle engine candidate/hardware efforts were revised 2007. (U) In FY 2003: Designed and developed concept hardware and fuel system simulators to evalue | t and advanced propulsion ity, toxicology, and hot ns by at least 50 percent. pte: Due to FY 2005-2007 I for a restart in post FY | 0.384 | 0.682 | 0.057 |
| (b) In FT 2005. Designed and developed concept nardware and rule system simulators to evalue components of reusable aerospace vehicles, focusing on aerospace vehicles with advanced a engines that require high levels of fuel cooling. Characterized hydrocarbon fuel candidates engines. Completed investigating fuel concepts that will maximize the performance of adva engines and minimize logistic costs. (U) In FY 2004: Continue to design and develop concept hardware and fuel system simulators temperature fuel system components of reusable aerospace vehicles, focusing on aerospace and combined cycle engines that require high levels of fuel cooling. Continue characterizat candidates and enhanced hardware concepts for combined cycle engines. | and combined cycle for combined cycle anced or combined cycle to evaluate key high vehicles with advanced | | | |
| (U) In FY 2005: Continue pilot-light level design and development of hardware and fuel system key high temperature fuel system components of reusable aerospace vehicles focusing on ac advanced and combined cycle engines that require high levels of fuel cooling. (U) | | | | |
| (U) MAJOR THRUST: Identify, develop, and demonstrate low-cost approaches to reducing the for the Expeditionary Air Force. Note: Due to FY 2005-2007 funding shifts, the FY 2005 revised for a restart in post FY 2007. | • | 0.841 | 0.400 | 0.047 |
| (U) In FY 2003: Determined the benefits of advanced additive packages to improve any commutate that can meet military standards. Developed novel methods to inject additives packages to a advanced field diagnostic techniques, such as smart nozzles, to assess fuel quality, additive and aid in mission planning by monitoring mission limiting fuel properties. Demonstrated a fuel identification and characterization. | improve fuels and injection requirements, a field-capable concept for | | | |
| (U) In FY 2004: Continue pilot-light development of novel methods for fuel analysis and addit the usable temperature range of commercially available aviation fuel through application of | | | | |
| including biologically related approaches. Demonstrate applicability of rapid fuel screening | • | | | |
| Project 2480 R-1 Shopping List - Item No | . 20-5 of 20-20 | | Exhibit R-2a (PE | 0603216F) |

| Februar BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND TITLE 063216F Aerospace Propulsion and Power Technology PROJECT NUMBER AND TITLE 2480 Aerospace Fuels a Atmospheric Propulsion (U) In FY 2005: Continue pilot-light development of novel methods including bio- and nano-technology for fuel analysis. 3.975 0.000 (U) CONGRESSIONAL ADD: Variable Flow Ducted Rocket (VFDR) Propulsion System. 3.975 0.000 (U) In FY 2003: Develop a preliminary design for an integrated tactical missile technology demonstrator using a VFDR. Developed conceptual designs for VFDR tactical missiles that are compatible with the internal carriage in the F/A-22. Defined a preliminary flight test plan. Developed high-fidelity models and simulations for engineering, engagement, and mission analysis. Performed critical experiments to reduce the risk of key component technologies. 11.498 3.101 (U) C. Other Program Funding Summary (\$ in Millions) 11.498 3.101 | nd |
|--|---------------|
| (U) In FY 2005: Continue pilot-light development of novel methods including bio- and nano-technology for fuel analysis. (U) (U) CONGRESSIONAL ADD: Variable Flow Ducted Rocket (VFDR) Propulsion System. (U) In FY 2003: Develop a preliminary design for an integrated tactical missile technology demonstrator using a VFDR. Developed conceptual designs for VFDR tactical missiles that are compatible with the internal carriage in the F/A-22. Defined a preliminary flight test plan. Developed high-fidelity models and simulations for engineering, engagement, and mission analysis. Performed critical experiments to reduce the risk of key component technologies. (U) In FY 2005: Not Applicable. (U) In FY 2005: Not Applicable. (U) Total Cost (II.498 3.101 | 0.000 |
| (U) Total Cost11.4983.101(U) C. Other Program Funding Summary (\$ in Millions) | |
| | 0.374 |
| Image: Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complet (U) Related Activities: PE 0602203F, Aerospace Propulsion. PE 0602102F, Materials. PE 0602204F, Aerospace Sensors. PE 0602204F, Aerospace Sensors. (U) PE 0603112F, Advanced Materials for Weapons Systems. This project has been coordinated through the Coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. Effects Advanced Effects | I OTAL COST |
| (U) D. Acquisition Strategy Not Applicable. Project 2480 R-1 Shopping List - Item No. 20-6 of 20-20 Exhibit R-2a | (PE 0603216F) |

| | E | xhibit R-2a, F | RDT&E Pro | ject Justif | fication | | | DATE | February | 2004 |
|-------------------|--|---|--|--|--|--------------------------------------|--------------------------------|---------------------------------------|--------------------------------------|-------------------------|
| | GET ACTIVITY dvanced Technology Development | t (ATD) | | | PE NUMBER AND 0603216F Aero Power Techno | ospace Prop | ulsion and | PROJECT NUME 3035 Aerospa | | chnology |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 3035 | | 5.728 | 4.185 | 4.297 | | 4.412 | 4.487 | | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) | A. Mission Description and Budget It This project develops and demonstrates technology enhances reliability and surv power system components developed ar power system weight. This project also density sources for directed energy weap | electrical power a vivability, and red e projected to pro develops and der | uces vulnerabi vide a two- to | lity, weight, an five-fold impr | nd life cycle cos | ts for manned a aft reliability a | and unmanned and maintainal | aerospace vehic pility, and a 20 p | cles. The electr ercent reduction | ical n in |
| (U) (U) (U) | B. Accomplishments/Planned Program MAJOR THRUST: Develop and demon- technologies for a next generation aerosp In FY 2003: Completed trade studies, de power system size, weight, and efficiency weapon systems. In FY 2004: Not Applicable. Note: In F In FY 2005: Not Applicable. | strate high-densit pace vehicle. etailed design, and y. Completed eva | critical techno luating electric | blogy develop c power techno | ment to optimize ology options fo | secondary r advanced | E | <u>7 2003</u> 1.921 | <u>FY 2004</u> 0.000 | <u>FY 2005</u> 0.000 |
| (U) (U) (U) | MAJOR THRUST: Develop power gene and subsystem technologies for integratio technologies will enable the delivery of h In FY 2003: Developed a high power, lo Yttrium Barium Copper Oxide sufficient In FY 2004: Fabricate and test high pow In FY 2005: Fabricate high power low d | on of high power high power for op- w duty cycle gen- to fabricate coate er, low duty cycle | subsystems wit eration of DEV erator for pulse d conductors f generator crit | th directed ene V. ed DEWs. Cor or cryogenic g ical componer | ergy weapons (D mpleted fabricat generators. | EW). These | | 0.815 | 1.190 | 1.560 |
| | MAJOR THRUST: Develop power gene management components and subsystem technologies will improve aircraft self-su cycle costs and enabling new capabilities In FY 2003: Developed a power electric | technologies for a fificiency, reliabil | manned and un ity, maintainab | manned aircra bility, and supp | aft systems. The portability, while | ese reducing life | | 1.009 | 2.043 | 1.974 |
| | ect 3035 | - • | | | m No. 20-7 of 20-2 | - | | | Exhibit R-2a (F | PE 0603216F) |
| | | 1 | | 32 | | I | | | | - |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DA | TE February | 2004 |
|--|--|---|-------------------------------------|---|-----------------------------------|-----------------------------------|----------------------------------|-----------------------------------|-------------------|
| BUDGET ACTIVITY 03 Advanced Technology Develop | ment (ATD) | | | PE NUMBER A 0603216F A Power Tech | erospace Pro | pulsion and | | JMBER AND TITLE space Power Te | |
| (U) In FY 2004: Initiate design of the c Fabricate and test large amp-hour (2) (U) In FY 2005: Complete detailed des engines. | 200) cells and ba | tteries. | - | | - | | | | |
| (U) MAJOR THRUST: Develop power components and subsystem technol (U) In FY 2003: Demonstrated advance provide reductions in both volume a | ogies that are syn ed power conditi and weight. | nergistic with air oning technolog | r, space, and weaties with motor of | apons platforms. | |) | 1.983 | 0.952 | 0.763 |
| U) In FY 2004: Fabricate low volume.U) In FY 2005: Test low volume/lowU) Total Cost | weight high temp | perature motor d | | | | | 5.728 | 4.185 | 4.297 |
| U) <u>C. Other Program Funding Sum</u> | <u>mary (\$ in Milli</u> <u>FY 2003</u> <u>Actual</u> | <u>ons)</u> FY 2004 <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimat</u> | | <u>Total Cost</u> |
| (U) Related Activities: (U) PE 0602203F, Aerospace (Propulsion. | | | | | | | | | |
| PE 0602201F, Aerospace Flight Dynamics. PE 0602605F, Directed Energy | | | | | | | | | |
| U) Technology. PE 0603605F, Advanced Weapons Technology. | | | | | | | | | |
| This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. | | | | | | | | | |
| (U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | | | | | | |
| Project 3035 | | R | | Item No. 20-8 of 2 326 | 20-20 | | | Exhibit R-2a (| PE 0603216F) |

| | Ext | nibit R-2a, R | ≀DT&E Pro | ject Justif | ication | | | DA | February | y 2004 |
|--|------------------------------------|-------------------|---------------------|--|---------------------|---------------------|---------------------|------------------------------------|----------------|--------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | | | | PE NUMBER AND 0603216F Aero Power Techno | ospace Prop | ulsion and | | UMBER AND TITLE raft Propulsion | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | | Total |
| 4921 | Aircraft Propulsion Subsystems Int | 33.809 | 28.600 | 16.719 | 19.647 | 15.036 | 26.533 | 26.9 | 920 Continuing | g TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | |

(U) <u>A. Mission Description and Budget Item Justification</u>

This project develops and demonstrates gas turbine propulsion system technologies applicable to aircraft. The Aerospace Propulsion Subsystems Integration (APSI) project includes demonstrator engines such as the Joint Technology Demonstrator Engine for manned systems and the Joint Expendable Turbine Engine Concept for unmanned air vehicle and cruise missile applications. The demonstrator engines integrate the core (high-pressure spool) technology developed under the Advanced Turbine Engine Gas Generator project with the engine (low-pressure spool) technology such as fans, turbines, engine controls, and exhaust nozzles. Additionally, these efforts include activities under the national High Cycle Fatigue program. This project also focuses on system integration of inlets, nozzles, engine/airframe compatibility, power and thermal management subsystems, and low-observable technologies. APSI provides aircraft with potential for longer range and higher cruise speeds with lower specific fuel consumption, surge power for successful engagements, high sortie rates with reduced maintenance, reduced life cycle cost, and improved survivability, resulting in increased mission effectiveness. Technologies developed are applicable to sustained high-speed vehicles and responsive space launch. The APSI supports the goals of the national Integrated High Performance Turbine Engine Technology (IHPTET) program, which is focused on doubling turbine engine propulsion capabilities while reducing cost of ownership. Anticipated technology advances include turbine engine improvements providing an approximate 30 percent reduction in tactical fighter aircraft takeoff gross weight and 100 percent increase in aircraft range/loiter. APSI is also fully integrated into the Versatile Affordable Advanced Turbine Engine program (VAATE). The IHPTET and VAATE programs provide continuous technology transition for military turbine engine upgrades and derivatives, and have the added dual-use benefit of enhancing the United States turbine engine industry's

| (U) | B. Accomplishments/Planned Program (\$ in Millions) | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
|-----|--|----------------|----------------|----------------|
| (U) | MAJOR THRUST: Design, fabricate, and demonstrate durability and integration technologies for turbofan/turbojet | 6.056 | 7.359 | 2.577 |
| | engines. These technologies will improve durability, supportability, and affordability of current and future Air Force | | | |
| | aircraft. | | | |
| (U) | In FY 2003: Completed analysis, fabrication, instrumentation, and assembly of an engine for structural/durability | | | |
| | testing. Completed refurbishment of the Advanced Turbine Engine Gas Generator, fabrication, and instrumentation | | | |
| | in preparation for final assembly of the Joint Technology Demonstrator Engine with fixed inlet guide vanes and | | | |
| | Moderate Aspect Ratio rotor, Integrally Bladed Rotor repair, fan rim damper, High Cycle Fatigue mistuning and | | | |
| | damping technologies, vaneless counter-rotating high/low pressure turbine, probabilistic rotor system design, gamma | | | |
| | titanium aluminide low pressure turbine coverplate, sprayform cast hardware, and Ceramic Matrix Composite | | | |
| | technologies. | | | |
| (U) | In FY 2004: Complete structural durability testing on an engine and performance testing of the Joint Technology | | | |
| | Demonstrator Engine containing fixed inlet guide vanes and a Moderate Aspect Ratio rotor, fan rim damper, High | | | |
| | Cycle Fatigue mistuning and damping technologies, vaneless counter-rotating high/low pressure turbine, probabilistic | | | |
| Pro | oject 4921 R-1 Shopping List - Item No. 20-9 of 20-20 | | Exhibit R-2a (| (PE 0603216F) |
| | 327 | | | |

| Exhibit R-2a, RDT&E Project Justificat | ion | DAT | [™] February 2 | 2004 |
|---|--|-------|------------------------------------|-------------|
| 03 Advanced Technology Development (ATD) 06032 | 216F Aerospace Propulsion and | | MBER AND TITLE aft Propulsion S | ubsystems |
| rotor system design, sprayform cast turbine case, and a high fuel/air ratio Impingement Film Initiate advanced engine designs for a sustained supersonic engine with advanced aero, mistu coatings, a Low Pressure Turbine with advanced thermal barrier coatings and microcircuit co- thermoplastic externals and health monitoring. (U) In FY 2005: Validate the High Cycle Fatigue Test Protocol by completing structural durabili- engine components and instrumentation. Enhance advanced engine designs for a sustained s advanced aero, mistuned fan with ice phobic coatings, a Low Pressure Turbine with advance and microcircuit cooling scheme, thermoplastic externals, and health monitoring. (U) (U) MAJOR THRUST: Design, fabricate, and test advanced component technologies for improve | aned fan with ice phobic poling scheme, ity testing of advanced upersonic engine with d thermal barrier coatings | 7.521 | 14.762 | 12.072 |
| consumption of turbofan/turbojet engines for fighters, bombers, sustained supersonic and hyp and transports. Each of these component technology innovations can be applied to a signific engine inventory and offer potentially significant performance enhancements to future aircrat (U) In FY 2003: Completed advanced engine designs and initiated fabrication of a High Cycle F an affordable Organic Matrix Composite (OMC) fan frame, a two-stage forward swept fan, a turbine (LPT) blade, an uncooled Ceramic Matrix Composite LPT blade, a Metal Matrix Cormodel-based flexible control with diagnostics. Initiated advanced engine designs for tandem shroud, carbon counter-rotating intershaft seal, and active augmenter screech control. | ant part of the Air Force's ft engineers. atigue robust front frame, tiled low pressure nposite shaft, and | | | |
| (U) In FY 2004: Complete fabrication, instrumentation, assembly, and test of a High Cycle Fatig affordable OMC fan frame, a two-stage forward swept fan, a tiled LPT blade, an uncooled Co LPT blade, a Titanium Matrix Composite shaft, and model-based flexible control with diagno demonstrator engine. Enhance advanced engine designs for a tandem fan with OMC tip shro counter-rotating intershaft seal, and active augmentor screech control. | eramic Matrix Composite ostics in an advanced | | | |
| (U) In FY 2005: Complete fabrication and initiate testing of a High Cycle Fatigue robust front fr fan frame, a two-stage forward swept fan, a tiled LPT blade, an uncooled Ceramic Matrix Cor- Titanium Matrix Composite shaft, and model-based flexible control with diagnostics. Comp designs for tandem fan with OMC tip shroud, carbon counter-rotating intershaft seal, and act control. | mposite LPT blade, a lete advanced engine | | | |
| (U) (U) MAJOR THRUST: Design, fabricate, and test advanced component technologies for limited technologies improve the performance, durability, and affordability of engines for missile and and hypersonic weapon applications. | - | 7.561 | 4.000 | 2.070 |
| (U) In FY 2003: Completed fabrication and commenced testing on an Organic Matrix Composit high-pressure turbine, and slinger combustor. Completed fabrication of a low volume combustor. | | | | |
| Project 4921 R-1 Shopping List - Item No. 2 | | | Exhibit R-2a (P | E 0603216F) |

| Exhibit R-2a, RDT&E | Exhibit R-2a, RDT&E Project Justification | | | | | | | | |
|--|--|-------|-----------------|--------------|--|--|--|--|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603216F Aerospace Propulsion Power Technology | | UMBER AND TITLE | Subsystems | | | | | |
| engine structural durability testing of a high stage loading splittered Completed study effort to identify critical technologies for a superso (U) In FY 2004: Complete engine structural durability testing of a high low-pressure turbine. Complete testing of an Organic Matrix Comp turbine, and slinger combustor. Complete testing of low volume con durability testing on an uncooled Ceramic Matrix Composite turbine nozzle. Initiate designs of advanced component technologies for int (U) In FY 2005: Initiate designs of advanced component technologies for include an advanced fan, a ceramic turbine, turbine with new advance | onic turbine engine powered missile. stage loading splittered fan and uncooled ceramic posite fan, an uncooled ceramic high-pressure mbustor. Complete fabrication and conduct e blisk/nozzle, and a Carbon/Carbon exhaust telligent and durability engine testing. For intelligent and durability engine testing to | | | | | | | | |
| (U) (U) MAJOR THRUST: Develop high-speed turbine engine technology (U) In FY 2003: Completed study to evaluate gas turbine technologies f ramjet/scramjet combined/combination cycle engines). (U) In FY 2004: Not Applicable. Note: In FY 2004, funding for this ef (U) In FY 2005: Not Applicable. | for next generation air and space vehicles. for long-range strike vehicles (e.g., gas turbine and | 1.710 | 0.000 | 0.000 | | | | | |
| (U) (U) CONGRESSIONAL ADD: Joint Expendable Turbine Engine Conc (U) In FY 2003: Designed and fabricated a fixed composite nozzle and JETEC Phase III demonstrator engine test. The JETEC goal is to de consumption, increase thrust/airflow ratio, and reduce production co unmanned vehicle turbine engines. These efforts will contribute to t assembly, and test of materials and high pressure ratio technologies. blades and advanced thermal barrier coated cast cool vanes. | added instrumentation to the combustor for the evelop turbine engines that reduce fuel osts for supersonic expendable and limited life the continued detailed design, fabrication, | 0.961 | 0.000 | 0.000 | | | | | |
| (U) In FY 2004: Not Applicable.(U) In FY 2005: Not Applicable.(U) | | | | | | | | | |
| (U) CONGRESSIONAL ADD: Advanced Turbine Engine Gas Generat (U) In FY 2003: Not Applicable. (U) In FY 2004: Design and fabricate advanced component technologie consumption of turbofan/turbojet engines for fighters, bombers, and assemble hardware from the advanced turbine engine gas generator. of the following components: two-stage forward swept fan, uncooled vane, Titanium Matrix Composite shaft and model-based flexible contechnology innovations can be applied to the Air Force's engine investigation. | es for improved performance and fuel I transports. Refurbish, fabricate, instrument and This gas generator will be used in engine testing d Ceramic Matrix Composite low pressure turbine ontrol with diagnostics. Each of these component | 0.000 | 2.479 | 0.000 | | | | | |
| | -1 Shopping List - Item No. 20-11 of 20-20 | | Exhibit R-2a (I | PE 0603216F) | | | | | |

| | Exhibit R- | -2a, RDT&E | Project Ju | stification | | | DA | TE February | 2004 |
|--|-------------------------------------|---------------------------------|-------------------|---|-----------------|-----------------|----------------|-------------------|-------------------|
| UDGET ACTIVITY 3 Advanced Technology Develop | oment (ATD) | | | PE NUMBER A 0603216F A Power Tech | erospace Pro | pulsion and | | JMBER AND TITLE | |
| performance enhancements to futu U) In FY 2005: Not Applicable. U) Total Cost | re aircraft engine | s. | | | | | 33.809 | 28.600 | 16.719 |
| U) <u>C. Other Program Funding Sum</u> | mary (\$ in Milli <u>FY 2003</u> | i <u>ons)</u> <u>FY 2004</u> | <u>FY 2005</u> | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> | <u>Cost to</u> | <u>Total Cost</u> |
| U) Related Activities PE 0602201F, Aerospace Flight Dynamics. PE 0602203F, Aerospace Propulsion. PE 0603003A, Aviation Advanced Technology. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication U) D. Acquisition Strategy Not Applicable. | <u>Actual</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | Estimat | e <u>Complete</u> | |
| | | | | | | | | | |
| Project 4921 | | R- | 1 Shopping List - | Item No. 20-12 of 2 | 20-20 | | | Exhibit R-2a | (PE 0603216 |

| | Ext | nibit R-2a, I | RDT&E Pro | oject Justif | ication | | | | DATE | February | 2004 | |
|--|---|---|--|---|--|---|------------------------------------|------------|---|------------------------------------|----------------------|--|
| | ET ACTIVITY Ivanced Technology Development (| ATD) | | c | PE NUMBER AND D603216F Aer Power Techno | ospace Prop | ulsion and | 4922 Sp | ROJECT NUMBER AND TITLE 922 Space & Missile Rocket Propulsion | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2 | 009 | Cost to | Total | |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estim | nate | Complete | | |
| 4922 | Space & Missile Rocket Propulsion | 1.344 | 12.739 | 6.039 | | 5.038 | 5.123 | | 5.204 | Continuing | TBD | |
| | Quantity of RDT&E Articles In FY 2003, space unique technology effe | 0 | 0 | 0 | ş | 0 | 0 | | 0 | | | |
| Sustai (U) | lidate all space unique activities. In this print of Strategic Systems and tactical methods and tactical methods. A. Mission Description and Budget Iter This project develops and demonstrates te surveillance efforts) and tactical rockets. costs are emphasized. Increased life and provide the surveile of the surveil of the survei of the surveil of the survei of th | issiles. n Justification chnologies for Characteristics | the sustainmen such as enviro | t of strategic s | ystems (includi tability, afforda | ng solid boost/1 bility, reliabilit | nissile propuls y, reduced we | sion, Post | Boost | Control, and as d operation and | ging and l launch | |
| | lightweight, advanced propulsion systems high-energy propellants. Technological a 20 percent and reduce hardware and opera Strategic Systems program and support th 3. Accomplishments/Planned Program (| dvances develo ation costs by aj e Integrated Hi | ped in this prog pproximately 3 | gram will impr 0 percent. The | ove the perform projects in this | nance of expensions program are p | dable systems' part of the Tech | payload | capabil | lities by approx | imately | |
| (U) M (U) I 5 (U) I | Accomposite the regrammed Frogram (MAJOR THRUST: Civilian salaries. n FY 2003: This project previously includ 3033. These funds represent the civilian sa n FY 2004: Not Applicable. n FY 2005: Not Applicable. | led space uniqu | - | | rred to PE 0603 | 500F, Project | | 1.344 | | 0.000 | 0.000 | |
| (U) M t (U) I (U) I i (U) I i (U) I | AAJOR THRUST: Develop and demonstr echnologies for Intercontinental Ballistic M 603500F, Project 5033, for the Technolog n FY 2003: Not Applicable. n FY 2004: Demonstrate component tech ncreased performance for the PBCS. Com- propellant for the Missile Propulsion Demo n FY 2005: Complete Phase I full-scale ri- lemonstration. Complete demonstration of nardware costs with increased performance | Missile (ICBM) y for the Sustain nologies with re- tinue hardware onstration-Phase isk reduction co f component tee | . Note: Effor nment of Strate eadily available development in e I. mponent devel chnologies with | ts support work egic Systems-F e materials to r ntegrating case lopments for th n readily availa | k being conduct Phase I. educe hardware e, nozzle, insulat ne advanced PB able materials to | e costs with tion, and CS o reduce | | 0.000 | | 6.501 | 1.721 | |
| Proje | ct 4922 | | R-1 Sho | opping List - Item | No. 20-13 of 20- | 20 | | | | Exhibit R-2a (I | PE 0603216F) | |

| | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | | DATE February | / 2004 | |
|---|---|--|---|--|--------------------------------|-------------|--------------------------|---------------------------|--------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Developi | ment (ATD) | | | PE NUMBER A 0603216F A Power Tech | erospace Pro | pulsion and | PROJECT NUMBER AND TITLE | | | |
| insulation, and propellant for the Mi | issile Propulsion | Demonstration | -Phase I. | | | | _ | | | |
| (U) | | | | | | | | | | |
| (U) MAJOR THRUST: Develop and de surveillance technologies for strateg Systems-Phase II. | | | | - | | | 0.000 | 6.238 | 4.318 | |
| (U) In FY 2003: Not Applicable. | | | | | | | | | | |
| (U) In FY 2004: Begin development of missile components for verification, surveillance models and tools to fur | , design, and mo | dification. Begi | in development o | f advanced agir | ng and | | | | | |
| (U) In FY 2005: Continue modeling an components. Begin to develop subc resulting data. Continue development Develop methods to apply these too | d simulation too components to te nt of aging and s | ls (Phase II) dev st the accuracy urveillance tool | velopment for ana of the tools and u s for predicting the | lyzing and development applate the mode the health of soli | eloping missile Is with the | | | | | |
| (U) Total Cost | - | | | | | | 1.344 | 12.739 | 6.039 | |
| (U) <u>C. Other Program Funding Sum</u> | narv (\$ in Milli | ons) | | | | | | | | |
| | FY 2003 | | FY 2005 | FY 2006 | FY 2007 | FY 2008 | <u>FY 2</u> | <u>009</u> <u>Cost to</u> | | |
| | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Esti | | Total Cost | |
| U) Related Activities: | | | | | | | | | | |
| U) PE 0602102F, Materials. | | | | | | | | | | |
| PE 0602601E Spacecraft | | | | | | | | | | |
| U) Technology. | | | | | | | | | | |
| U) PE 0603401F, Advanced | | | | | | | | | | |
| Spacecraft Technology. | | | | | | | | | | |
| PE 0603853F, Evolved | | | | | | | | | | |
| U) Expendable Launch Vehicle | | | | | | | | | | |
| Program. | | | | | | | | | | |
| U) PE 0603114N, Power Projection | | | | | | | | | | |
| Advanced Technology. | | | | | | | | | | |
| This project has been coordinated through the | | | | | | | | | | |
| U) Reliance process to harmonize | | | | | | | | | | |
| efforts and eliminate | | | | | | | | | | |
| duplication. | | | | | | | | | | |
| Project 4922 | | D | -1 Shopping List - I | em No. 20-14 of | 20-20 | | | Evhihit P 20 | (PE 0603216F | |
| | | N | | 332 | | | | | | |

| Exhibit P 20 P | | DATE |
|---|--|---|
| | DT&E Project Justification | February 2004 |
| UDGET ACTIVITY 3 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology | PROJECT NUMBER AND TITLE 4922 Space & Missile Rocket Propulsion |
| D) D. Acquisition Strategy Not Applicable. | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Project 4922 | R-1 Shopping List - Item No. 20-15 of 20-20 | Exhibit R-2a (PE 0603216F |

| | Ex | hibit R-2a, I | RDT&E Pro | oject Justif | ication | | | DA | February | 2004 | |
|---|---|--|---|--|---|---|--|--|---|---------------------------------------|--|
| BUDGET / 03 Adva | ACTIVITY anced Technology Development | (ATD) | | C | 0603216F Aerospace Propulsion and | | | | PROJECT NUMBER AND TITLE 5098 Advanced Aerospace Propulsion | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | O Cost to | Total | |
| | Cost (\$ III MIIIIOIIS) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | e Complete | | |
| 5098 | Advanced Aerospace Propulsion | 0.000 | 15.750 | 26.300 | 10.819 | 20.387 | 23.605 | 23.0 | 074 Continuing | TBD | |
| | Quantity of RDT&E Articles FY 2004, this Project is a new project. | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | |
| Th (in Mu scr du by | Mission Description and Budget Iter is project develops the scramjet propul acluding turbine and rocket based) to pro- ulti-cycle engines will provide the prop- ramjet flow-path optimization to enable ring mode transition), robust flame-hol the high-speed engine. Thermal mana opulsion systems during hypersonic flip | lsion cycle to a t rovide revolution pulsion systems the operation over lding to maintain agement plays a | nary propulsion necessary to su the widest pose n stability through | n options for th apport aircraft a ssible range of a ugh flow distor | he Air Force. The and weapon plate Mach numbers, tions, and maxi | he primary focu tforms operatin active combus mized volume- | is is on the hy- g over the ran tion control to to-surface area | drocarbon-fu ge of Mach (assure conti a to minimiz | ueled, scramjet eng 0 to 8+. Efforts ind inuous positive thru the thermal load | ine. Elude 1st (even imposed | |
| (U) MA over (U) In F (U) In F oper flan Mac duri and (U) In F the desi | Accomplishments/Planned Program JOR THRUST: Develop and demonst r a range of Mach 4 to 8. PY 2003: Not Applicable. Note: Activ PY 2004: Design and fabricate a fixed rations over a range of Mach 4.5 to 7+ ne-holding/fuel-mixing geometry. Dev ch 4.5. Initiate design of an active eng- ing acceleration. Initiate vehicle design hydrocarbon fuel system, and accelerate PY 2005: Initiate ground test of the hydrocarbon fuel system, and accelerate rations are ready the overall de- rumentations, scramjet propulsion syst al Cost | ities were previe geometry flow-j to include optin velop a robust er ine sense-contro n capable of roc ation from Mach drocarbon-fuelee ele. Conduct win | busly part of or both for a hydr nization of the agine start syste l system to ma ket-boost to M 4.5 to 7+. Ini d, fixed geome and tunnel testir gn (includes ai | ther projects in ocarbon-fueled flow-path cross em to achieve f mage start trans fach 4, full integ tiate selection of try flow path. ng of the air vel ir vehicle struct | this PE. I scramjet with the s-section and the full engine light sient and engine gration with scr of rocket booste Continue detail hicle models. C tures, avionics, | robust e after boost to e mode changes amjet engine ers. ed design of | 3 | <u>7 2003</u> 0.000 0.000 | <u>FY 2004</u> 15.750 15.750 | <u>FY 2005</u> 26.300 26.300 | |
| Project 5 | 5098 | | <u>R-1 Sh</u> | opping List - Item | n No. 20-16 of 20- | 20 | | | Exhibit R-2a (| PE 0603216F) | |

| | Exhibit R-2a, RD | T&E Project Justification | | DATE February 2004 | |
|---|---|--|--------------------------|--------------------------|--|
| BUDGET ACTIVITY D3 Advanced Technology Development (ATD) | | PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology | PROJECT NUMBER AND TITLE | | |
| U) | C. Other Program Funding Summary (\$ in Millions) | | | | |
| U) | D. Acquisition Strategy Not Applicable | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Pro | ject 5098 | R-1 Shopping List - Item No. 20-17 of 20-20 | | Exhibit R-2a (PE 0603216 | |

| | Ex | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 | |
|------|---|---|---|--|--|---|---|--|--|---------------------------------|--|
| | GET ACTIVITY dvanced Technology Development | (ATD) | | 0 | PE NUMBER AND 1603216F Aer Power Techno | ospace Prop | | ROJECT NUMBER AND TITLE 81B Advanced Turbine Engine Gas Generator | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | |
| 681H | Advanced Turbine Engine Gas Generator | 31.688 | 29.050 | 26.185 | 26.425 | 26.914 | 27.365 | 27.803 | Continuing | TBD | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| | This project develops turbine engine gas technologies into an advanced gas generation gas generator, or core, is the basic buildi enhances early, low-risk transition of key technologies are applicable to a wide ran Component technologies are demonstrate Efforts are part of the Integrated High Pe | ator in which the ng block of the e y engine technolo nge of military an ed in a core (sub- | performance, ngine and it co ogies into engin d commercial engine) test. | cost, durability onsists of a com neering develop systems includ The core perfor | r, reparability, a apressor, a component, where the ing aircraft, mis- mances of this | nd maintainabi bustor, and a hi ney can be appl ssiles, land com project are prov | lity can be ass gh-pressure tu ied to derivati abat vehicles, s ven in demons | essed in a real or irbine. Experin ve and/or new s ships, and respo trator engines i | engine environn nental core engin systems. These onsive space lau n Project 4921 o | nent. The ne testing nch. | |
| (U) | B. Accomplishments/Planned Program MAJOR THRUST: Design, fabricate, and including Titanium Matrix Composites, to | d test performand | | | | | | <u>7 2003</u> 26.579 | <u>FY 2004</u> 24.390 | <u>FY 2005</u> 21.866 | |
| (U) | engines for fighters, attack aircraft, bomb transports. Each of these technology inno inventory and offer potentially significant In FY 2003: Completed design and conti compressor aerodynamics, a trapped vorte | ovations can be ap t performance en nued hardware fa ex combustor wit | oplied to a sign nancements to brication of a h a ceramic ma | future aircraft future aircraft core engine tes atrix composite | the Air Force's engines. t article with an e combustor line | engine a advanced er, a ceramic | | | | | |
| | matrix composite vane, magnetic bearings testing of a high-pressure ratio four stage cooled turbine blade outer airseals, revolu thinwall supercooled turbine blades. Prel Integrated Lightweight Combustor with in high pressure turbine blades with advance | compressor with ationary hot section iminarily designed integrated vane particular at thermal barrier | an integrated l on material, ad ed a core engin ick, a cooled-co coating. | lightweight cor vanced Therma e test article wa ooling air syste | nbustor that has al Barrier Coati ith a 6-stage co em, and micro-c | s microcircuit ng, and mpressor, an ircuit cooled | | | | | |
| | In FY 2004: Continue hardware fabrication trapped vortex combustor with ceramic multiplication of the second secon | hatrix composite on of hardware for the combustor with | combustor line core engine te integrated van | rs, magnetic be esting of a high- he pack, a coole | earings, and adv -pressure ratio s ed cooling air sy | vanced turbine six-stage | | | | | |
| Proj | ect 681B | | R-1 Sho | opping List - Item | No. 20-18 of 20- | 20 | | | Exhibit R-2a (I | PE 0603216F) | |

| Exhibit R-2a, RDT&E Project Justification | DA | TE February 2004 | |
|---|--------|---|------------|
| BUDGET ACTIVITY PE NUMBER AND TITLE 03 Advanced Technology Development (ATD) 0603216F Aerospace Propulsion at Power Technology | | UMBER AND TITLE anced Turbine Engine G | Gas |
| (U) In FY 2005: Continue hardware fabrication of a core engine test article with advanced compressor aerodynamics, a trapped vortex combustor with ceramic matrix composite combustor liners, magnetic bearings, advanced turbine blisk and advanced turbine vane materials. Complete design and initiate fabrication of hardware for core engine testing of a cooled-cooling air system, and micro-circuit cooled high pressure turbine blades with advanced thermal barrier coating. (U) | | | |
| (U) MAJOR THRUST: Design, fabricate, and durability test demonstration core engines to provide increased durability and affordability for turbofan/turbojet engines for fighters, attack aircraft, bombers, sustained supersonic and hypersonic cruise vehicles, and large transports. | 1.826 | 1.506 1.5 | 00 |
| (U) In FY 2003: Designed and initiated fabrication of long lead hardware for turbine engine advanced hardware for core engine evaluations in the national durability programs.(U) In FY 2004: Enhance the design and continue fabrication of long lead hardware for turbine engine advanced core | | | |
| evaluations in the national durability programs.(U) In FY 2005: Complete the design and continue fabrication of long lead hardware for turbine engine advanced hardware for core engine evaluation in the national durability programs. | | | |
| (U) (U) MAJOR THRUST: Design, fabricate, and evaluate technology demonstration core engines to provide improved performance and fuel consumption for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large unmanned air vehicles. | 3.283 | 3.154 2.8 | ;19 |
| (U) In FY 2003: Advanced core engine testing of a forward swept splittered compressor rotor, a high temperature rise combustor, a counter- rotating vaneless turbine, and ceramic matrix composite turbine blades and vanes. | | | |
| (U) In FY 2004: Continue core engine testing of a forward swept splittered compressor rotor, a high temperature rise combustor, a counter-rotating vaneless turbine, ceramic matrix composite turbine blades and vanes, and magnetic bearings. | | | |
| (U) In FY 2005: Complete core engine testing of a forward swept splittered compressor rotor, a high temperature rise combustor, a counter- rotating vaneless turbine, ceramic matrix composite turbine blades and vanes, and magnetic bearings. Initiate design of small versatile affordable core engine technologies. | | | |
| (U) Total Cost | 31.688 | 29.050 26.1 | .85 |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | | |
| <u>FY 2003</u> <u>FY 2004</u> <u>FY 2005</u> <u>FY 2006</u> <u>FY 2007</u> <u>FY 2007</u> <u>Actual Estimate Estimate Estimate Estimate Estimate</u> | _ | – Total Co | <u>ost</u> |
| (U) Related Activities: (U) PE 0602201F, Aerospace Flight | | | |
| Project 681B R-1 Shopping List - Item No. 20-19 of 20-20 337 | | Exhibit R-2a (PE 060321 | 16F) |

| Exhibit R-2a, RDT&E F | Project Justification | | DATE | | | |
|--|--|--|----------------------------|--|--|--|
| | • | | February 2004 | | | |
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | | | | | | |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Dynamics. PE 0602203F, Aerospace Propulsion. (U) PE 0603003A, Aviation Advanced Technology. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | | | |
| Project 681B R-1 | Shopping List - Item No. 20-20 of 20-20 338 | | Exhibit R-2a (PE 0603216F) | | | |

PE NUMBER: 0603231F PE TITLE: Crew Systems and Personnel Protection Technology

| | Exhib | oit R-2, RDT | F&E Budge | t Item Just | ification | | | DATE | February | 2004 |
|------|--|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------|---------------------|-------|
| | ACTIVITY anced Technology Development (| ATD) | | | PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology | | | | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| | Total Program Element (PE) Cost | 37.959 | 42.822 | 32.794 | 32.525 | 33.129 | 33.685 | 34.224 | Continuing | TBD |
| 2830 | Decision Support and Cognitive Systems | 8.128 | 8.865 | 6.369 | 6.236 | 6.187 | 6.291 | 6.393 | Continuing | TBD |
| 3257 | Helmet-Mounted Sensory Technologies | 7.304 | 7.636 | 4.788 | 5.327 | 5.421 | 5.511 | 5.599 | Continuing | TBD |
| 4923 | Logistics Readiness and Sustainment | 7.076 | 12.463 | 10.532 | 10.847 | 11.204 | 11.393 | 11.575 | Continuing | TBD |
| 4924 | Distributed Mission Training Technology | 6.535 | 6.475 | 7.220 | 7.160 | 7.161 | 7.281 | 7.397 | Continuing | TBD |
| 5020 | Directed Energy Protective Systems | 8.916 | 7.383 | 3.885 | 2.955 | 3.156 | 3.209 | 3.260 | Continuing | TBD |

Note: In FY 2003, the Directed Energy Protective Systems program at Brooks City-Base, Texas, moved from Project 3257 to Project 5020 to align resources with the Air Force Research Laboratory organization.

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to enhance human performance and effectiveness and to enable the aerospace force. State-of-the-art advances are made to train personnel, protect and sustain warfighters, and improve human interfaces with weapon systems. The Decision Support and Cognitive Systems project develops and demonstrates crew system interface technologies and information operations technologies that promote effective decision-making, control, and execution in operational environments. The Helmet-Mounted Sensory Technologies project develops and demonstrates advanced operator interface technologies for multi-functional helmet-mounted displays and night vision devices, and laser eye protection. The Logistics Readiness and Sustainment project develops and demonstrates technologies that will protect the force, enhance logistics, and improve the design, deployability, performance, and support of current and future weapon systems. The Distributed Mission Training Technology project develops and demonstrates advanced training, simulation, and mission rehearsal technologies. The Directed Energy Protective Systems project develops and demonstrates advanced technologies for laser eye protection and for assuring the safety of personnel involved with test, deployment, and operation of high-energy laser weapons and systems. Note: In FY 2004, Congress added \$1.4 million for Laser Eye Protection Research, \$1.4 million for Virtual Warriors, \$1.8 million for Crew Systems Personnel Protection, \$1.7 million for Helmet Cueing System, \$1.0 million for The Logistics Institute, and \$1.4 million for Total Atmospheric Liquefaction for Oxygen and Nitrogen (TALON).

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies to protect and enhance the performance of Air Force personnel in operational environments.

R-1 Shopping List - Item No. 21-1 of 21-21

| dget Item Justification | DATE February 2004 | | | | | |
|--|---|---|--|--|--|--|
| PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology | | | | | | |
| | | | | | | |
| <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | | | | |
| 39.235 | 34.487 | 32.881 | | | | |
| 37.959 | 42.822 | 32.794 | | | | |
| -1.276 | 8.335 | | | | | |
| | | | | | | |
| | -0.365 | | | | | |
| | 8.700 | | | | | |
| -0.542 | | | | | | |
| -0.734 | | | | | | |
| | | | | | | |
| | | | | | | |
| | PE NUMBER AND TITLE 0603231F Crew Systems and Personnel FY 2003 39.235 37.959 -1.276 -0.542 | Endget Item Justification Februa PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technolog <u>FY 2003</u> <u>SY 2004</u> <u>39.235</u> <u>34.487</u> <u>37.959</u> <u>42.822</u> <u>-1.276</u> <u>8.335</u> <u>-0.365</u> <u>8.700</u> <u>-0.542</u> | | | | |

| | ExI | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|------------|---|--|--|---|--|--|---|--|--|--|
| | GET ACTIVITY Advanced Technology Development (| (ATD) | | c | PE NUMBER AND 0603231F Cre Personnel Pro | w Systems a | nd | PROJECT NUME 2830 Decisio Systems | BER AND TITLE | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 283 | Systems | 8.128 | 8.865 | 6.369 | 6.236 | 6.187 | 6.291 | 6.393 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | This project provides technology to impro- station integration, which are achievable the warfighter and equipment across the g develops technologies to quantify require includes bioacoustic technologies to comp the Air Expeditionary Force environment and security forces. | through effectiv gamut of aerospa ments, develop plement decision | e decision supp ace operations. information int n support and v | port and cognit To cope with terfaces, and ev visual informat | ive systems eng the recognized valuate crew per ion technologie | tineering. Crew data overload i rformance in se s as part of an i | v stations represent n command control lected operation ntegrated solu | esent the fundar enters and weap onal environment tion to negate in | nental interface on platforms, th nts. This project nformation over | between his project ct rload in |
| | B. Accomplishments/Planned Program MAJOR THRUST: Develop and demonst enhance battlespace situational awareness centers to reduce decision-making bottlene | rate user-tailore for global- and l | | - | · · | - | <u>F</u> Y | <u>7 2003</u> 2.708 | <u>FY 2004</u> 3.222 | <u>FY 2005</u> 1.500 |
| (U) | In FY 2003: Transitioned and integrated in weapon systems. Developed decision-make and assess alternative ways they may be far front-end and advanced visualization for o time-critical targeting information into stri inherent with helmet-mounted display tech In FY 2004: Develop a decision-making madversary systems and to assess alternative this tool into next-generation planning and planning. Develop dynamic user tailoring In FY 2005: Integrate a decision-making maker the systems and the system of the | king process and worably influence perations center ke aircraft to en mology. nodeling, simula ways they may combat assess for operation ce modeling, simul | I model to char ced by allied for s' information to hance pilot situ ation, and analy be favorably in nent tools to de enters' informat ation, and analy | acterize differe orce actions. D management to national awaren ysis tool to eva nfluenced by a emonstrate enh ion manageme ysis tool into f | ent types of adv Developed speec bol. Improved f ness, exploiting luate different t illied force actionanced information anced information ent tool. inal version of p | ersary systems h recognition low of capabilities ypes of ons. Integrate on warfare | | | | |
| | demonstrated combat assessment tool and collaborative information sharing for opera- version information management tool into | ation centers' inf | formation mana | agement tool. | - | - | | | | |
| (U) Pro | oject 2830 | | R-1 Sh | opping List - Iten | n No. 21-3 of 21-2 | 21 | | | Exhibit R-2a (I | PE 0603231F) |

| Exhibit R-2a, RDT&E | Exhibit R-2a, RDT&E Project Justification | | | | | | | | | |
|---|--|-------|--|--------------|--|--|--|--|--|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology | | CT NUMBER AND TITLE Decision Support and Cognitive Ins | | | | | | | |
| (U) MAJOR THRUST: Develop advanced high-performance bioacousti 40-45 dB noise attenuation for personnel working in and around figh (U) In FY 2003: Demonstrated communication capability in 150 dB noise technology with active noise reduction to achieve 45 dB field attenua user acceptability in laboratory and field environments. | ter aircraft. se fields. Integrated deep insert earplug ation. Demonstrated improved attenuation and | 0.893 | 0.000 | 0.000 | | | | | | |
| (U) In FY 2004: Not Applicable. Note: Major thrust completed in FY 2 (U) In FY 2005: Not Applicable. (U) | 2003. | | | | | | | | | |
| (U) MAJOR THRUST: Develop and demonstrate advanced audio technologies and threat response time using acoustic sensors. | ologies to enhance security force situational | 1.459 | 0.947 | 0.000 | | | | | | |
| (U) In FY 2003: Demonstrated to deployed security forces an improved intelligent algorithms, three-dimensional (3-D) audio, and audio sym threat intervention. Demonstrated at a military exercise the operation helmets in a mobile patrol squadron. Developed an automated threat importance of detected noise. | bology to code the detected threats and assist in nal payoff from using 3-D audio radios and | | | | | | | | | |
| (U) In FY 2004: Demonstrate a user-centered interface to improve threa command, as well as automated acoustic threat detection, localization air vehicles, and munitions firing. Demonstrate during a military exe combination of acoustic sensors, multimedia displays at the comman assist mobile patrol squads. | n and classification of foot traffic, land vehicles, ercise the operational payoff from using the | | | | | | | | | |
| (U) In FY 2005: Not Applicable. Note: Technology will transition to S | pecial Operations Forces in FY 2004 for testing. | | | | | | | | | |
| (U) (U) MAJOR THRUST: Develop and demonstrate human-centered scien Warfare (IW) community. This technology will provide the IW warf guidelines for effective selection of information warriors, information improved operational shift schedules to increase personnel efficiency tools, and automated tools to reduce operator task load. | rior with tailored decision support systems, n operations simulators and training systems, | 1.320 | 1.970 | 2.069 | | | | | | |
| (U) In FY 2003: Performed initial operating capability (IOC) baseline reinfluence human senses. Technologies will enable perception manage behavior, develop adversary cultural and decision models, enhance printeraction and monitoring capability by determining effectiveness or information warfare units. | gement and deception, model and simulate human oredictive battlespace awareness, and improve | | | | | | | | | |
| (U) In FY 2004: Develop technologies to provide human-centered altern | • | | | | | | | | | |
| processes, and operations. Technologies will focus on predictive bat | | | | | | | | | | |
| Project 2830 R- | -1 Shopping List - Item No. 21-4 of 21-21 342 | | Exhibit R-2a (F | 2E 0603231F) | | | | | | |

| | Exhibit R- | ·2a, RDT&E | Project Jus | tification | | | DATE | February | 2004 | |
|--|---|---|--|--|---|----------------------------|--|-----------------------------------|---------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Develop | ment (ATD) | | | | ND TITLE rew Systems Protection Tec | | PROJECT NUMBER AND TITLE 2830 Decision Support and y Systems | | | |
| systems and tools to augment huma modernization plan for IW as well requirements.(U) In FY 2005: Develop and demonst information. | as a detailed plan trate tools, metho | to support futur | re demonstration | s of IW tools, tr | aining, and attack | | | | | |
| information. Identify and prioritize and methods. Develop, demonstrat | | · · · • | | • | | es | | | | |
| (U) (U) MAJOR THRUST: Develop and d reporting, situation assessment upd New application of technology in F | ates, and decision | n support for Co | ••• | - | | | 0.000 | 1.338 | 2.800 | |
| (U) In FY 2003: Not Applicable.(U) In FY 2004: Perform cognitive tas | k analysis of key | CAOC position | s and develop m | easures of perfo | rmance and | | | | | |
| effectiveness. Begin to develop vis (U) In FY 2005: Develop user-tailorab awareness. Demonstrate enhanced operations between CAOC and oth | sualizations prom le visualizations collaborative cap | noting battlespac to optimize hum pability for effec | e situational awa | reness. battlespace situ | ational | | | | | |
| (U) | - | | | | | | | | | |
| (U) CONGRESSIONAL ADD: Virtua in FY 2003. | l Warriors. Note | : Formerly know | wn as Combat A | utomation Requ | irement Testbec | l | 1.748 | 1.388 | 0.000 | |
| (U) In FY 2003: Extended human mod system concepts and mission effect manning within air operations centre effectiveness and affordability. De objectively and systematically asse (U) In FY 2004: Integrate human mode manning within air operations centre (U) In FY 2005: Not Applicable. | tiveness. Analyzers, showing con eveloped extensions the overall sem- eling and simulat | ed and developed tribution of hum ons to the simulat isor-to-shooter p ion technologies | d integrated crew an modeling to s tion testbed that rocess for time-os into distributed | v system concep ubstantiate time will provide the ritical targets. simulation exer | ts to reduce -critical targetin capability to | g | | | | |
| (U) Total Cost | | | | | | | 8.128 | 8.865 | 6.369 | |
| (U) <u>C. Other Program Funding Sum</u> | - | | | | | | | | | |
| | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> Estimate | <u>FY 2005</u> Estimate | <u>FY 2006</u> Estimate | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> Estimate | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | Total Cost | |
| (U) Related Activities:(U) PE 0602202F, Human | | | | | | | | <u> </u> | | |
| Project 2830 | | R | -1 Shopping List - | Item No. 21-5 of 2 | 1-21 | | | Exhibit R-2a | (PE 0603231E) | |

| Exhibit R-2a, RDT&E P | Project Justification | I | DATE February 2004 |
|--|---|---|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology | | NUMBER AND TITLE cision Support and Cognitive |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Effectiveness Applied Research. (U) PE 0604706F, Life Support Systems. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. | | | |
| Project 2830 R-1 | Shopping List - Item No. 21-6 of 21-21 344 | | Exhibit R-2a (PE 0603231F) |

| | Exhibit R-2a, F | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|--|---|---|---|---|--|---------------------|--|---------------------|--------------|
| BUDGET ACTIVITY 03 Advanced Technology Deve | lopment (ATD) | | Q | PE NUMBER AND 0603231F Cre Personnel Pro | w Systems a | | PROJECT NUME 3257 Helmet- Technologies | Mounted Ser | nsory |
| Cost (\$ in Million | s) FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| 3257 Helmet-Mounted Sensory Technologies | 7.304 | 7.636 | | | 5.421 | 5.511 | | Continuing | TBD |
| Quantity of RDT&E Articl | es 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) A. Mission Description and J. This project develops and dem helmet-mounted tracker and d improved aircrew Night Visio (U) B. Accomplishments/Planned (U) MAJOR THRUST: Develop a subsystem technologies to impu- missions in all-weather condition faster and more accurately. (U) In FY 2003: Investigated and co- situational awareness, and redu improve tracker accuracy. Inve- future simulations and flight even (U) In FY 2004: Demonstrate adva improvements to targeting, to in assess utility of advanced head footprint. | nonstrates advanced technol isplay (HMT/D) technologi n Goggle (NVG) technologi Program (\$ in Millions) and demonstrate advanced H rove mission effectiveness a ons. These technologies hel leveloped advanced symbol ce spatial disorientation. Ir estigated utility of advanced aluations. anced symbology sets for ta ancrease situational awarene | es will enable ies will enhand elmet-Mounte and pilot situat p pilots to dete logy sets for ta tegrated ultras daytime HMT ctical HMT/De ss, and to redu | pilots to detect ce aerial comba ed Tracker and ional awarenes ect, identify, tar actical HMT/Ds sonic transduce F/D incorporati s in an operatio ce spatial disor | t, identify, targe at capabilities a Display (HMT/ ss during day an rget, and engage s to improve tar ers with inertial ing miniature co onal environmen rientation. Dem | t, and launch w t night. D) and d night e with weapons geting, increase head tracker to blor display for nt to assess nonstrate and | reapons faster | • | - | |
| (U) In FY 2005: Assess capability tracker at night to reduce target HMT/D to destroy time-critical laboratory. | acquisition and engagemen | nt timelines. D | emonstrate real | l-time target inf | formation on | | | | |
| (U) (U) MAJOR THRUST: Develop a mission effectiveness and enha (U) In FY 2003: Incorporated and | nce air operations by allowi | ng the pilot to | perform daytin | me tactics at nig | ght. |) | 1.504 | 0.000 | 0.000 |
| Project 3257 | | R-1 Sh | opping List - Iten | n No. 21-7 of 21-2 | 21 | | | Exhibit R-2a (I | PE 0603231F) |
| | | | 345 | 5 | | | | | |

| Exhibit R-2a, RDT&E Pr | ced Technology Development (ATD) 0603231F Crew Systems and | | | | | | |
|---|---|-------|---|-------|--|--|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | | | IMBER AND TITLE et-Mounted Ser jies | isory | | | |
| with the Integrated Panoramic Night Vision Goggle. (U) In FY 2004: Not Applicable. Note: Technology transitioned to Joint F Office in FY 2003. (U) In FY 2005: Not Applicable. | Helmet Mounted Cueing System Program | | | | | | |
| (U) (U) MAJOR THRUST: Develop and demonstrate advanced visual display capability for reducing pilot workload and enhancing mission performa FY 2004 from previous major thrust. | | 0.000 | 2.910 | 2.943 | | | |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Assess capabilities of emerging night vision devices and in displays. Develop technologies to reduce bulk and head-supported weig designs to improve aircrew safety and comfort. | - | | | | | | |
| (U) In FY 2005: Develop and integrate miniature digital night vision devic displays to optimize display of information to aircrew. Investigate the u and video to the aircrew to reduce time looking at head-down displays i technologies to support fielding of laser eye protection and laser harden Helmet-Mounted Tracker and Displays and night vision goggles. | utility of new displays for providing imagery in the cockpit. Assess leading edge display | | | | | | |
| (U) (U) MAJOR THRUST: Develop and demonstrate subsystems to protect the Displays (HMDs) during emergency ejection in current and future high lift-reducing helmet concepts will provide a decrease in head and neck is during high-speed emergency ejections. | -performance fighter aircraft. Aerodynamic | 0.937 | 0.727 | 0.000 | | | |
| (U) In FY 2003: Conducted tests to verify head, neck, and eye protection a (KEAS) threshold, 700 KEAS objective. | re provided to 600 Knots Equivalent Air Speed | | | | | | |
| (U) In FY 2004: Identify candidate lift-reducing concepts and integrate hel Conduct impact, windblast, and ejection sled tests to verify performance (U) In FY 2005: Not Applicable. Note: Major thrust will be completed in | e under high-speed ejection conditions. | | | | | | |
| (U)(U) CONGRESSIONAL ADD: Helmet Cueing System Technology. | | 0.970 | 1.686 | 0.000 | | | |
| (U) In FY 2003: Developed and demonstrated advanced head tracker techn for onboard weapons and sensors. | nologies to improve helmet cueing capabilities | | | 0.000 | | | |
| (U) In FY 2004: Transition the advanced head tracker and related helmet convironment to the operational environment. Develop and package the with an operational aircraft's sensors and weapons, in preparation for a sensor of the sensor of | advanced head tracker including integration | | | | | | |
| | Shopping List - Item No. 21-8 of 21-21 | | Exhibit R-2a (F | | | | |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DAT | [⊤] February | 2004 | |
|--|---|---------------------------------|---|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|--------------------------|-------------------|--|
| | ET ACTIVITY Ivanced Technology Develop | | PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology | | | | | PROJECT NUMBER AND TITLE 3257 Helmet-Mounted Sensory Technologies | | | |
| U) In | apability. n FY 2005: Not Applicable. 'otal Cost | | | | | | | 7.304 | 7.636 | 4.788 | |
| U) <u>(</u> | C. Other Program Funding Sum | <u>mary (\$ in Milli</u> | <u>ons)</u> | | | | | | | | |
| (U) F (U) F (U) F (U) F (U) F (U) S (U) S (U) A (U) A (U) A (U) F (U) F | Related Activities: PE 0602202F, Human Effectiveness Applied Research. PE 0602102F, Materials. PE 0603112F, Advanced Materials for Weapon Systems. PE 0603319F, Airborne Laser Program. PE 0604706F, Life Support Systems. PE 0604201F, Integrated Avionics Planning and Development. This project has been coordinated through the Reliance process to harmonize efforts and eliminate | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> Estimate | | <u>Total Cost</u> | |
| d [U] <u>]</u> | luplication. D. Acquisition Strategy Not Applicable. | | | | | | | | | | |

| | Ext | nibit R-2a, F | RDT&E Pro | oject Justif | ication | | | DAT | E February | 2004 |
|--------------------------|--|--|--|---|--|---|----------------------------------|-------------------------------------|--|-------------------------|
| | GET ACTIVITY dvanced Technology Development (| ATD) | | | PE NUMBER AND 0603231F Crev Personnel Pro | w Systems a | | | MBER AND TITLE ti cs Readiness nt | and |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 4923 | | 7.076 | 12.463 | 10.532 | | 11.204 | 11.393 | | 2 | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | (|) | |
| (U) | A. Mission Description and Budget Item This project develops and demonstrates te command and control systems; enhance th This includes technologies to model and s status of logistics resources and aircraft st warfighter decision-making in the areas of | chnologies that the fidelity and a imulate intellig atus; and to per | ccuracy of larg ent behavior; t form earlier pr | ge-scale militan o better integra ediction of the | ry simulations; a ate the human w effects of expos | and improve the ith computer-b sure to hazardo | e protection of ased informat | f personnel in o ion systems; to | deployed enviror provide near re | nments. al-time |
| (U) (U) (U) (U) | B. Accomplishments/Planned Program (MAJOR THRUST: Develop and demonstration behavior models. These computer agents a environments and war games, provide intellinteraction with logistics information system interaction with logistics information system and control echelons. These agent-based in world. In FY 2004: Demonstrate software archite personality types. The models being devel- at the air component commander level of co In FY 2005: Develop human behavior base command and control echelons and that bet | rate intelligent s and models will ligence analysts ms. ware agents tha nodels incorpora cture for behavio oped will simul ontrol. ed computer models | add realism ar s a way to mod c emulate poten ated cultural be or modeling the ate potential en- odels that enab | nd fidelity to la lel collected da ntial enemy int ehavioral differ nat can be read nemy comman le the study of | rge-scale synthe ata, and improve regrated air defe rences observed ily tuned to diff d and control de information ope | etic the user nse command in the real erent ecision-making | _ | <u>Y 2003</u> 2.200 | <u>FY 2004</u> 2.777 | <u>FY 2005</u> 2.123 |
| (U) (U) (U) | MAJOR THRUST: Develop and demonstr improved system supportability. These tec deployments and mobility operations in sup concepts. In FY 2003: Developed initial software too logistics information and management capa proactive problem identification, decision so In FY 2004: Complete development of sof | rate logistics technologies will a poport of Agile C ol set to provide abilities, includi support, and pro- | hnologies for naximize the e combat Suppor wing comman ng rapid acces cess tracking. | improved depl efficiency and out initiatives an orders and senions to real-time to | oyment operation effectiveness of d Air Expedition or logisticians waresources status | Air Force nary Force ith advanced information, | | 2.540 | 4.489 | 3.072 |
| Proi | ect 4923 | | R-1 Sho | oppina List - Item | n No. 21-10 of 21-2 | 21 | | | Exhibit R-2a (| PE 0603231F) |
| | | | | 24 | | | | | | |

| global air mobility command and control systems. These technologies will provide command and control operators with automated access to a manageable amount of critical information from multiple sources to avoid operator overload and thus support faster, more accurate decision-making and problem resolution during mobility operations. (U) In FY 2003: Developed and demonstrated software to provide advanced user interfaces by combining intelligent agents and artificial intelligence software with automated, work-centered collaborative planning and decision support technologies to automatically identify weather impacts on air mobility missions. (U) In FY 2004: Develop artificial intelligence software, work-centered collaborative planning tools, and advanced decision support technologies to augment global air mobility command and control systems. (U) In FY 2005: Continue to develop artificial intelligence software that can automatically draw conclusions, develop work-centered collaborative planning tools, and develop advanced decision support technologies. Demonstrate these | |
|--|-------|
| information, proactive problem identification, decision support, and process tracking. Begin to assess and develop technology to automatically collect and update critical information required to effectively manage logistics resources in support of combat operations. (U) In FY 2005: Continue to develop and apply technology to automatically collect and update critical information required to effectively manage logistics resources in support of combat operations. Begin to design and develop very fast, easy-to-use simulation capabilities for Air Force units to optimally apply limited logistics resources during operation. (U) (U) MAJOR THRUST: Develop and demonstrate advanced job performance aiding technologies to enhance the utility of 1.366 1.471 2 global air mobility command and control systems. These technologies will provide command and control operators with automated access to a manageable amount of critical information from multiple sources to avoid operator overload and thus support faster, more accurate decision-making and problem resolution during mobility operations. (U) In FY 2003: Developed and demonstrates of tware to provide advanced user interfaces by combining intelligent agents and artificial intelligence software with automated, work-centered collaborative planning and decision support technologies to automatically identify weather impacts on air mobility command and control systems. (U) In FY 2004: Develop artificial intelligence software that can automatically draw conclusions, develop work-centered collaborative planning tools, and advanced decision support technologies. Demonstrate these | |
| fast, easy-to-use simulation capabilities for Air Force units to optimally apply limited logistics resources during operation. (U) (U) MAJOR THRUST: Develop and demonstrate advanced job performance aiding technologies to enhance the utility of 1.366 1.471 2 global air mobility command and control systems. These technologies will provide command and control operators with automated access to a manageable amount of critical information from multiple sources to avoid operator overload and thus support faster, more accurate decision-making and problem resolution during mobility operations. (U) In FY 2003: Developed and demonstrated software to provide advanced user interfaces by combining intelligent agents and artificial intelligence software with automated, work-centered collaborative planning and decision support technologies to automatically identify weather impacts on air mobility missions. (U) In FY 2004: Develop artificial intelligence software, work-centered collaborative planning tools, and advanced decision support technologies to augment global air mobility command and control systems. (U) In FY 2005: Continue to develop artificial intelligence software that can automatically draw conclusions, develop work-centered collaborative planning tools, and develop work-centered collaborative planning tools. | |
| (U) MAJOR THRUST: Develop and demonstrate advanced job performance aiding technologies to enhance the utility of 1.366 1.471 2 global air mobility command and control systems. These technologies will provide command and control operators with automated access to a manageable amount of critical information from multiple sources to avoid operator overload and thus support faster, more accurate decision-making and problem resolution during mobility operations. (U) In FY 2003: Developed and demonstrated software to provide advanced user interfaces by combining intelligent agents and artificial intelligence software with automated, work-centered collaborative planning and decision support technologies to automatically identify weather impacts on air mobility missions. (U) In FY 2004: Develop artificial intelligence software, work-centered collaborative planning tools, and advanced decision support technologies to augment global air mobility command and control systems. (U) In FY 2005: Continue to develop artificial intelligence software that can automatically draw conclusions, develop work-centered collaborative planning tools. Demonstrate these | |
| (U) In FY 2003: Developed and demonstrated software to provide advanced user interfaces by combining intelligent agents and artificial intelligence software with automated, work-centered collaborative planning and decision support technologies to automatically identify weather impacts on air mobility missions. (U) In FY 2004: Develop artificial intelligence software, work-centered collaborative planning tools, and advanced decision support technologies to augment global air mobility command and control systems. (U) In FY 2005: Continue to develop artificial intelligence software that can automatically draw conclusions, develop work-centered collaborative planning tools, and develop advanced decision support technologies. Demonstrate these | 613 |
| (U) In FY 2004: Develop artificial intelligence software, work-centered collaborative planning tools, and advanced decision support technologies to augment global air mobility command and control systems. (U) In FY 2005: Continue to develop artificial intelligence software that can automatically draw conclusions, develop work-centered collaborative planning tools, and develop advanced decision support technologies. Demonstrate these | |
| (U) In FY 2005: Continue to develop artificial intelligence software that can automatically draw conclusions, develop work-centered collaborative planning tools, and develop advanced decision support technologies. Demonstrate these | |
| technologies in an operational environment within the Tanker Airlift Control Center. | |
| (U) | |
| (U) MAJOR THRUST: Develop and demonstrate technologies that will enhance and streamline aircraft maintenance 0.000 2.734 2 processes to improve the Air Force's ability to meet Air Expeditionary Force requirements by providing faster and more accurate methods of diagnosing and predicting component failures. 0.000 2.734 2 | 724 |
| (U) In FY 2003: Not Applicable. Note: Funds redirected to higher Air Force priorities. | |
| (U) In FY 2004: Begin to develop cognitive decision technologies, new information fusion techniques, and algorithms to determine failure trends for improved maintenance troubleshooting. Develop revolutionary formats for presenting technical information and software tools that support collaborative problem-solving during aircraft maintenance. | |
| (U) In FY 2005: Continue to develop cognitive decision technologies, new information fusion techniques, and algorithms to determine failure trends for improved maintenance troubleshooting. Continue to develop revolutionary formats for presenting technical information and software tools that support collaborative problem solving during aircraft maintenance. | |
| (U) | |
| Project 4923 R-1 Shopping List - Item No. 21-11 of 21-21 Exhibit R-2a (PE 0603) 240< | 231F) |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | | 2004 |
|--|--|-----------------------------|----------------------------|-----------------------------------|---|---|-----------------------------------|-----------------------------------|---------------|
| BUDGET ACTIVITY 03 Advanced Technology Develop | | | • | PE NUMBER A 0603231F C | ND TITLE rew Systems Protection Tec | PROJECT NUMBER AND TITLE 4923 Logistics Readiness and Sustainment | | | |
| (U) CONGRESSIONAL ADD: The Lo Battlespace Logistics Readiness and (U) In FY 2003: Developed and demor processes and improve the design, o systems. | d Sustainment. | gies that will enl | hance Air Force | maintenance and | d supply | | 0.970 | 0.992 | 0.000 |
| (U) In FY 2004: Continue to develop a processes and improve the design, c systems. (U) In FY 2005: Not Applicable. | | | | | | T | | | |
| (U) Total Cost | | | | | | | 7.076 | 12.463 | 10.532 |
| (U) <u>C. Other Program Funding Sum</u> | mary (\$ in Millie FY 2003 <u>Actual</u> | ons) FY 2004 Estimate | <u>FY 2005</u> Estimate | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | Total Cost |
| (U) Related Activities: (U) PE 0602201F, Aerospace Flight Dynamics. (U) PE 0602202F, Human (U) Definition of the second secon | | | | | | | | | |
| (U) Effectiveness Applied Research. (U) PE 0603721N, Environmental Protection. | | | | | | | | | |
| (U) PE 0604708F, Civil, Fire, Environmental, Shelter. PE 0604740F, Integrated | | | | | | | | | |
| (U) Command and Control Applications. | | | | | | | | | |
| (U) PE 0605801A, Programwide Activities. PE 0708011F, Industrial | | | | | | | | | |
| (U) Preparedness. This project has been (U) Reliance process to harmonize efforts and eliminate | | | | | | | | | |
| Project 4923 | | R- | | Item No. 21-12 of 2 | 21-21 | | | Exhibit R-2a | (PE 0603231F) |

| | Exhibit R-2a, RD | T&E Project Justification | | DATE February 2004 | | |
|------------|---|---|--------|---|--|--|
| | GET ACTIVITY Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology | 4923 L | PROJECT NUMBER AND TITLE 4923 Logistics Readiness and Sustainment | | |
| U) | <u>C. Other Program Funding Summary (\$ in Millions)</u> | | | | | |
| | duplication. | | | | | |
| (U) | D. Acquisition Strategy Not Applicable. | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Dro | ject 4923 | R-1 Shopping List - Item No. 21-13 of 21-21 | | Exhibit R-2a (PE 060323 | | |

| | Ex | hibit R-2a, F | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|--|--|--|--|---|---|---|---|--|---|---|
| | ET ACTIVITY dvanced Technology Development | (ATD) | | Q | PE NUMBER AND 0603231F Crev Personnel Pro | w Systems a | | PROJECT NUME 4924 Distribu Technology | | Training |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 4924 | Technology | 6.535 | 6.475 | 7.220 | 7.160 | 7.161 | 7.281 | 7.397 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | This project develops and demonstrates a by enhancing operator and team perform and weapon system simulators to portray operations. This project develops and de and mission rehearsal capabilities. Deve and representation technologies. The res support individuals and teams that comp | ance skills. This the global battle emonstrates adva lopment and effe sulting mission tr | effort include espace, includi nced training a ective use of th aining and reh | s the developm ng all-weather, and simulation is global battle | ent of technolo day/night fligh technologies that space requires a | gies that enable t operations, co at will improve advances in tra | e integration o ommand and c warfighter rea ining systems, | f computer mod ontrol, force pro adiness by enhag interconnection | els, live weapo otection, and ae ncing mission t a, information, | n systems, rospace raining visual, |
| (U)] | B. Accomplishments/Planned Program MAJOR THRUST: Advance warfighter i control, force protection, and air base defe efficiency, and decrease time to mission q | ntegrated trainin ense warfighters. ualification. | Technologies | s will increase t | raining effectiv | eness and | <u>F</u> Y | <u>7 2003</u> 2.422 | <u>FY 2004</u> 1.680 | <u>FY 2005</u> 1.063 |
| 1 | In FY 2003: Developed and validated train nission essential skills. Implemented and Training (DMT) testbed. | | | - | | | | | | |
| 1 1 1 1 1 1 (U) 1 1 1 1 | In FY 2004: Develop mission essential co knowledge, skills, and experiences that are Develop specifications for virtual and live personnel to maintain mission essential sk integrated command and control training v simulator performance measurement and to racking capability for live-fly instrumente (In FY 2005: Develop and validate capability rehearsal technology suite for full combat Complete collaborative toolset for mission simulation performance measurement cap | e important enable training perform tills, and develop within the DMT tracking system, ed range data. ility to conduct i tions for a deploy tactical weapons n analysis and tra | lers of mission nance assessme training and s environment. and develop a ntegrated comp vable Distribut s employment acking. Demon | n performance f ent and measur imulation techn Demonstrate co stand-alone pe mand and contr ed Mission Op- mission plannin nstrate an integ | for individuals a ement to enable nologies that wi ompetency-base rformance mon rol and combat erations (DMO) ng, training, and rated live-fly ar | and teams. e deployed ill enable ed design of a itoring and employment) training and d rehearsal. nd virtual | | | | |
| Proje | ect 4924 | | R-1 Sho | opping List - Item | No. 21-14 of 21-2 | 21 | | | Exhibit R-2a (| PE 0603231F) |

| | Exhibit R-2a, RDT&E Project | Justification | DA | February | 2004 |
|------------|--|---|-------|-----------------|--------------|
| | GET ACTIVITY Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology | | MBER AND TITLE | |
| | development, assessment, and decay study for combat air forces. | | | | |
| (U) (U) | MAJOR THRUST: Develop and demonstrate the application of information ar realistic mission training and mission rehearsal in a distributed simulation envir increase readiness training by enabling more realistic employment of weapon sy vertically integrated system of sensors, command and control, and weapons pla | onment. These technologies will ystems within a horizontally and | 0.679 | 1.288 | 0.000 |
| (U) | In FY 2003: Demonstrated the capability to establish a High-Level Architectur aircrew and command and control training to geographically separated audience to enable distributed mission training to operate at multiple security levels. | • | | | |
| (U) | In FY 2004: Demonstrate a near-real-time HLA based training environment en control training for geographically separated training audiences. Validate perfor federation operating at multiple security levels and produce documentation to su | ormance of an HLA network guard | | | |
| (U) | In FY 2005: Not Applicable. Note: Technology will transition to the Distribut FY 2004. | ted Mission Operations Center in | | | |
| (U) | | | | | |
| (U) | MAJOR THRUST: Demonstrate advances in simulator visual system technolo ultrahigh resolution projection systems, low-cost high-fidelity image generator, display technologies. Technologies will create high-definition immersive virtua training and mission rehearsal, increasing mission rehearsal capability for the w | and thin-film holographic collimating al environment for aircrew readiness | 1.568 | 1.785 | 3.280 |
| (U) | In FY 2003: Developed and demonstrated less expensive, thin-film holographic the simulator. Developed and demonstrated a proof-of-concept ultrahigh resolut and evaluated high-bandwidth PC-based image generator with high-resolution l | c collimating display components for ition, color laser projector. Integrated | | | |
| (U) | In FY 2004: Fabricate and evaluate efficient, full-size, thin-film holographic co 5120 x 4096 pixel low-cost PC-based image generator. | 1 0 | | | |
| (U) | In FY 2005: Design and fabricate the frame and display structure for the next visual display system. Integrate proof-of-concept ultrahigh-resolution laser pro- interfaces, capable of displaying over ten times the resolution currently displayed Television (HDTV) projectors. Design and develop high-performance, low-cos- commodity graphics along with a high-resolution terrain database to provide vis- Integrate advanced visual technologies to create the 20/20 Immersive Visual Di- | jectors with open-standard external ed by commercial High-Definition st image generator based on sual and sensor imagery at 60 HZ. | | | |
| (U) | | | | | |
| (U) | MAJOR THRUST: Develop and demonstrate training technologies and technic device-aided night operations. These technologies will reduce the cost of Night and increase combat capability. | | 1.866 | 0.843 | 1.400 |
| Pro | oject 4924 R-1 Shopping I | List - Item No. 21-15 of 21-21 | | Exhibit R-2a (I | PE 0603231F) |
| | | 353 | | | |

| | Exhibit R- | ·2a, RDT&E | Project Jus | tification | | | DATE | February | 2004 |
|---|---|---|--|---|---|-----------------------------------|----------------------------|-----------------------------------|------------|
| BUDGET ACTIVITY 03 Advanced Technology Develo | pment (ATD) | | | | ND TITLE rew Systems Protection Tec | | | BER AND TITLE | |
| (U) In FY 2003: Completed generic I tools used for NVG functionality, imagery. Developed proof-of-con Completed digital conversion of i scenarios for initial qualification, (U) In FY 2004: Develop guidelines fidelity NVG simulation into Dist metrics for NVG scan, crosscheel NVG initial and continuation trai. (U) In FY 2005: Develop the functio suitable for initial NVG familiarize evaluate simulator based spatial on NVG visual simulation on mission | allowing for high- ncept for dual mode introductory and in- spatial orientation, to introduce NVG tributed Mission Tr k and spatial orienta- ning. Develop an ai- nal specification fo zation training, mis- prientation scenario | -fidelity, comple le, covert and over structor coursew, , and advanced c training during p raining and Form tation. Develop a unnual NVG refre or a desktop Nigh ssion planning/pross for NVG use. | etely correlated v ert, external aircr vare. Developed combat night ope pilot training. Tr nal Training Unit and evaluate two esher course suit ht Vision Goggle review, and mish | isible and senso raft lighting for simulator-based rations. ransition and im t facilities. Dev o-ship simulator able for use in c e (NVG) visuali ap investigation | r simulation fighter aircraft. I training plement high elop performanc scenarios for leployed status. zation trainer h. Develop and | ce | | | |
| (U) (U) MAJOR THRUST: Develop and rehearsal capability for operators and principles of instruction to en operational units. | in an Air Operation able effective and | ns Center (AOC) efficient training |). Link AOC op g at both the AO | erational missio C Formal Traini | n requirements ng Unit and the | | 0.000 | 0.879 | 1.477 |
| (U) In FY 2003: Not Applicable. Not (U) In FY 2004: Develop specification rehearsal within an AOC. Develop members. Explore individual-lev | ons, strategies, and op preliminary guid | methods for ind delines and metri | lividual-, team-, a | and division-lev | el training and | ЭС | | | |
| (U) In FY 2005: Develop preliminary alternative content development a development. Evaluate alternative experiments. | competency-based and delivery method | d requirements for ds. Develop too | or use at the open ols and authoring | shells for cours | eware | | | | |
| (U) Total Cost | | | | | | | 6.535 | 6.475 | 7.220 |
| (U) <u>C. Other Program Funding Su</u> | | | | | | | | C | |
| | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> Estimate | <u>FY 2007</u> Estimate | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> Estimate | <u>Cost to</u> <u>Complete</u> | Total Cost |
| (U) Related Activities: (U) PE 0602202F, Human Effectiveness Applied Research. | | <u></u> | <u></u> | | <u></u> | <u>Domine</u> | Lonnuc | | |
| | | | | | | | | | |

| Exhibit R-2a, RDT&E Pro | pject Justification | | DATE February 2004 | |
|---|---|--|--------------------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLEPFnology Development (ATD)0603231F Crew Systems and49Personnel Protection TechnologyTechnology | | | |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> (U) PE 0604227F, Distributed Mission Training. This project has been coordinated through the (U) Reliance process to harmonize | | | | |
| efforts and eliminate duplication. | | | | |
| (U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | |
| Project 4924 R-1 Sh | opping List - Item No. 21-17 of 21-21 | | Exhibit R-2a (PE 0603231 | |

| BUDGET ACTIVITY PE NUMBER AND TILE 0603231F Crew Systems and Personnel Protection Technology PROJECT NUMBER AND TILE 0603231F Crew Systems and Personnel Protecticin Technology PROJECT NUMBER AND TILE 05020 <u>Cost (\$ in Millions)</u> FY 2003 FY 2004 FY 2005 FY 2007 FY 2008 FY 2009 Total <u>5020</u> Directed Energy Protective Systems 8.916 7.383 3.885 2.955 3.156 3.209 3.240 Continuing TBI <u>Quantity of RDT&E Arctics</u> 0 | | Ext | nibit R-2a, I | RDT&E Pro | oject Justi | fication | | | DATE | February | 2004 | |
|--|---|--|--|---|---|--|--|---|---|---|-------------------------------------|--|
| Cost S in Millions) Actual Estimate Estimate Estimate Estimate Complete 5020 Directed Energy Protective Systems 8.916 7.383 3.885 2.955 3.156 3.200 3.260 Continuing TBI Quantity of RDTAE Articles 0 </th <th></th> <th></th> <th>ATD)</th> <th></th> <th></th> <th>0603231F Cre</th> <th>w Systems a</th> <th></th> <th colspan="4">5020 Directed Energy Protective</th> | | | ATD) | | | 0603231F Cre | w Systems a | | 5020 Directed Energy Protective | | | |
| Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete Quantity of RDT&E. Articles 0 <t< th=""><th></th><th>Cost (\$ in Millions)</th><th>FY 2003</th><th>FY 2004</th><th>FY 2005</th><th>FY 2006</th><th>FY 2007</th><th>FY 2008</th><th>FY 2009</th><th></th><th>Total</th></t<> | | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | | Total | |
| Quantity of RDT&E Articles 0 </th <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>1 1</th> <th></th> | | | | | | | | | | 1 1 | | |
| Note: In FY 2003, the Directed Energy Protective Systems program at Brooks City-Base, Texas, moved from Project 3257 to Project 5020 to align resources with the Air Force Research Laboratory organization. (U) A.Mission Description and Budget Item Justification This project develops and demonstrates advanced technologies for Laser Eye Protection (LEP) and for assuring safety of personnel involved with test, deployment, and operation of high-energy laser wapons and systems. The project develops technologies to provide protection against laser threats and hzards, without compromising performance, vigilance, and mission effectiveness. It also develops tools and guidelines for testing and deploying high-energy laser systems and technologies to enhance personnel safety and effectiveness in aerospace operations. (U) B.Accomplishments/Planned Program (B in Millions) EY 2003 EY 2004 EY 2005 (U) MAIOR THRUST: Develop and demonstrate multi-wavelength Laser Eye Protection (LEP) technologies for aircrew 1.305 1.586 1.600 and ground personnel to provide protection against any laser hazard or threat in a single device. (U) In FY 2003: Evaluated LEPAscr-hardeck with laser Detector and Warning system toward integration into aircraft cockpits and with multi-wavelengt LEP. (U) In FY 2004: Begin evaluating and integrating optical limiters, tunable liquid crystals, photochromic and evelopment, integration of LEP, pectaces with laser hardenden VXOs. Continue development, integration and valuation of a Laser Detector and Warning system toward integration into aircraft cockpits and agile LEP. </td <td>5020</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>3.156</td> <td></td> <td></td> <td>2</td> <td>TBD</td> | 5020 | | | | | | 3.156 | | | 2 | TBD | |
| Research Laboratory organization. (U) A.Mission Description and Budget Item Justification This project develops and demonstrates advanced technologies for Laser Eye Protection (LEP) and for assuring safety of personnel involved with test, deployment, and operation of high-energy laser weapons and systems. It also develops tools and guidelines for testing and deploying high-energy laser systems and technologies to enhance personnel safety and effectiveness in aerospace operations. EY 2003 EY 2004 EY 2005 (U) B.Accomplishments/Planned Program (& in Millions) EY 2003 EY 2004 EY 2005 (U) MAJOR THRUST: Develop and demonstrate multi-wavelength Laser Eye Protection (LEP) technologies for aircrew and ground personnel to provide protection against any laser hazard or threat in a single device. 1.305 1.586 1.600 (U) In FY 2003: Evaluated LEP/laser-hardened night vision goggle compatibility and integration issues. Evaluated performance of mini-band clip-on device to provide selected, multi-wavelength LEP, eackpits and with multi-wavelength LEP. EV 1.586 1.600 (U) In FY 2003: Evaluate LEP/laser barceneds with laser-hardened NVGs. Continue development, integration, and evaluation of LEP spectacles with laser-hardened NVGs. Continue development, integration, and evaluation of LEP sectacles with laser-hardened NVGs. Continue development and evaluation of a Laser Detector and Warning system toward integration into aircraft cockpits and agile LEP. Evaluate human performance of second mini-band clip-on device to provide selected, multi-wavelength LEP. EV < | | | , v | ÿ | , | , v | 0 | 0 | 0 | | | |
| and ground personnel to provide protection against any laser hazard or threat in a single device. (U) In FY 2003: Evaluated LEP/laser-hardened night vision goggle compatibility and integration issues. Evaluated performance of mini-band clip-on device to provide selected, multi-wavelength LEP and received safe-to-fly certification. Demonstrated first phase of a Laser Detector and Warning system toward integration into aircraft cockpits and with multi-wavelength LEP. (U) In FY 2004: Begin evaluating and integrating optical limiters, tunable liquid crystals, photochromic and electrochromic materials, reflective technologies, and advanced dyes toward demonstration of agile LEP. Continue development, integration, and evaluation of LEP spectacles with laser-hardened NVGs. Continue supporting development and evaluation of a Laser Detector and Warning system toward integration into aircraft cockpits and agile LEP. Evaluate human performance of third mini-band clip-on device to provide selected, multi-wavelength LEP. (U) In FY 2005: Evaluate human performance of third mini-band clip-on device to provide selected, multi-wavelength LEP. Complete support for development and evaluation of a Laser Detector and Warning system for integration into aircraft cockpits and agile LEP. Complete aircrew evaluations of peripheral LEP protection for wear with laser hardened Night Vision Goggles. (U) WAJOR THRUST: Develop and demonstrate technologies that permit safe testing, deployment, and use of 0.707 0.869 1.435 | (U) (U) <u>F</u> | A. Mission Description and Budget Iter This project develops and demonstrates ac operation of high-energy laser weapons an performance, vigilance, and mission effec personnel safety and effectiveness in aero B. Accomplishments/Planned Program (| dvanced techno nd systems. Th ctiveness. It als space operation (\$ in Millions) | e project devel o develops tool 1s. | ops technolog ls and guidelin | gies to provide pr nes for testing an | otection agains ad deploying hig | t laser threats gh-energy lase <u>F</u> | and hazards, w er systems and t <u>Y 2003</u> | ithout comprom technologies to o <u>FY 2004</u> | nising enhance <u>FY 2005</u> | |
| (U) MAJOR THRUST: Develop and demonstrate technologies that permit safe testing, deployment, and use of high-energy laser weapons and systems. (U) In FY 2003: Completed laboratory experiments and field measurements to support initial Validation, Verification, Project 5020 R-1 Shopping List - Item No. 21-18 of 21-21 Exhibit R-2a (PE 0603231F) | (U) I F c c c c c c c c c c u I e d d d d I I (U) I I e d d d I I E c c c c c c c c c c c c c c c c c | nd ground personnel to provide protection n FY 2003: Evaluated LEP/laser-hardene erformance of mini-band clip-on device to ertification. Demonstrated first phase of a ockpits and with multi-wavelength LEP. n FY 2004: Begin evaluating and integrat lectrochromic materials, reflective techno evelopment, integration, and evaluation o levelopment and evaluation of a Laser Det gile LEP. Evaluate human performance of LEP. n FY 2005: Evaluate human performance LEP. Complete support for development a ircraft cockpits and agile LEP. Complete | a against any las d night vision g o provide select a Laser Detecto ting optical limi logies, and adv f LEP spectacle tector and Warr of second mini-b of third mini-b and evaluation of | ser hazard or the goggle compati- ted, multi-wave r and Warning atters, tunable lie anced dyes tow es with laser-ha- ning system tow pand clip-on de of a Laser Detect | reat in a single bility and interest elength LEP a system towar quid crystals, vard demonstrest ardened NVGs vard integration evice to provident vice to provident | le device. gration issues. E nd received safe- d integration into photochromic an ration of agile LE s. Continue supp on into aircraft co de selected, multi- le selected, multi- ning system for in | Evaluated -to-fly o aircraft ed EP. Continue porting ockpits and i-wavelength -wavelength ntegration into | | 1.305 | 1.586 | 1.600 | |
| | (U) M | igh-energy laser weapons and systems. | - | - | - | | | | 0.707 | 0.869 | 1.435 | |
| | Proje | ct 5020 | | R-1 Sho | | | 21 | | | Exhibit R-2a (| PE 0603231F) | |

| Exhibit R-2a, RDT&E Project | Justification | DAT | February | 2004 |
|--|---|-------|----------------------------------|--------------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology | | MBER AND TITLE ted Energy Pro | tective |
| and Accreditation of Version 1, Laser Range Safety Tool for Test Range Comr High Energy Laser Systems. Completed several key bioeffects studies to anch sub-microsecond high-energy laser pulses. Integrated a biological dose-respon assessment of laser hazards, into the Laser Range Management Software for us hazard analyses. (U) In FY 2004: Release version 2.0 of Laser Range Safety Tool (LRST) and com | or the damage threshold on se curve, required for probabilistic risk te in Advance Tactical Laser collateral | | | |
| personnel to permit rapid analysis of high energy laser test operations. Integral safety parameters for computer code supporting LRST. Refine software dama weapons based on bioeffects studies and field test measurements. | te laser bioeffects data to refine laser | | | |
| (U) In FY 2005: Begin development effort for real-time LRST permitting commar response on laser safety predictions arising from use of the Airborne Laser. De Assessment as an approach to high energy laser range safety. Complete revision near infrared wavelengths. Begin development of Phase II of the LRST. | emonstrate Probabilistic Risk | | | |
| (U) | | | | |
| (U) MAJOR THRUST: Develop and demonstrate biomolecular sensors to support and neutralization of biological weapons. Note: Technology from PE 0602202 thrust in FY 2005. | • | 0.000 | 0.000 | 0.494 |
| (U) In FY 2003: Not Applicable. | | | | |
| (U) In FY 2004: Not Applicable. | | | | |
| (U) In FY 2005: Develop and demonstrate spore, bacterial, viral, and toxin simular develop the critical microbiology required for simulant testing of counterforce sub- to full-scale testing of tracking and tracing capabilities of simulants in con- weapons tests for counterproliferation. | and neutralization concepts. Conduct | | | |
| (U) | | | | |
| (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate Lase the form of spectacles and visors for aircrew and ground personnel to provide p minimizing negative impacts on vision. Note: This effort includes \$0.9 millio funding and \$1.4 million in FY 2004 Congressional Add funding for Laser Eye | protection from lasers while n in FY 2003 Congressional Add | 1.465 | 1.755 | 0.356 |
| (U) In FY 2003: Completed evaluation of protective performance, visual acuity in compatibility, and aircrew acceptability of next-generation LEP, designed to pu while protecting against a second laser in the visible spectrum. Developed and platforms and for special operations teams. Demonstrated and evaluated LEP Accelerated operational utility evaluations of prescription-capable LEP and inc 'pop-up' laser threats. | pacts, life support equipment ovide acceptable visual performance demonstrated LEP for air-based laser with vision corrective prescriptions. | | | |
| | List - Item No. 21-19 of 21-21 | | Exhibit R-2a (F | PF 0603231F) |
| A renopping | 357 | | | |

| Exhibit R-2a, RDT&E Project Ju | ustification | Di | DATE February 2004 | | |
|---|--|-------|--------------------------------------|--------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology | | IUMBER AND TITLE cted Energy Prot | ective | |
| (U) In FY 2004: Begin design and development of a laser protective visor compatible Continue demonstration and evaluation of LEP for air-based laser platforms. Eval acuity impacts, equipment compatibility, and user acceptability of LEP for special technology for vision corrective prescription Laser Eye Protection (LEP), and for visible laser line protection. Accelerate development of LEP for Air Force Special forces; finish LEP spectacles for the Airborne Laser and the Advanced Tactical La corrective spectacles ahead of baseline schedule. | luate protective performance, visual operations teams. Transition wide-band, near-infrared, and two al Operations Command ground | | | | |
| (U) In FY 2005: Continue development and integration of LEP with night vision gogg technologies towards integrating with LEP. Begin development of standardized n human visual performance of potential component technologies for future LEP de LEP visor for the Advanced Tactical Laser. | nethods for evaluating effects on | | | | |
| (U) (U) CONGRESSIONAL ADD: Total Atmospheric Liquefaction for Oxygen and Nitr (U) In FY 2003: Designed, fabricated, and tested a palletized advanced technology de of oxygen and nitrogen for airlift aircraft. Technology could increase the availabit fuel tank inerting; provide high-purity oxygen for aircrew, paratrooper, and patien dependency on the costly and extensive deployment footprint of liquid oxygen. Faliquefaction of nitrogen and oxygen from compressed air, and produced a detailed palletized system. (U) In FY 2004: Continue development of component technologies for the palletized Technology will increase the availability of high-purity nitrogen gas for fuel tank for aircrew, paratrooper, and patient life support; and reduce aircraft dependency or support. | monstrator for on-board production lity of high-purity nitrogen gas for t life support; and reduce aircraft abricated and tested a cryocooler for aircraft integration plan for the TALON technology demonstrator. inerting; provide high-purity oxygen on the costly and extensive | 3.399 | 1.388 | 0.000 | |
| deployment footprint of liquid oxygen. Fabricate full-scale oxygen and nitrogen of columns with cryocooling technologies. Continue to refine aircraft integration platechnology demonstrator on-board a heavy aircraft.(U) In FY 2005: Not Applicable.(U) | | | | | |
| (U) CONGRESSIONAL ADD: Special Operations Crew Research at Brooks Air For (U) In FY 2003: Developed technologies to counter warfighter fatigue, identify and n reduce casualties and attrition in special operations training and operations. (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. | | 2.040 | 0.000 | 0.000 | |
| (U) (U) CONGRESSIONAL ADD: Crew Systems Personnel Protection. | | 0.000 | 1.785 | 0.000 | |
| Project 5020 R-1 Shopping List | - Item No. 21-20 of 21-21 358 | | Exhibit R-2a (F | 'E 0603231F) | |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | | DATE February | 2004 | |
|--|--|-----------------------------|---|----------------------------|---------------------|---------------------|----------------|--|-------------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Develop | oment (ATD) | | PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology | | | | | PROJECT NUMBER AND TITLE 5020 Directed Energy Protective Systems | | |
| (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop and demonst Special Operations Forces. (U) In FY 2005: Not Applicable. (U) Total Cost | trate technologies | and tailor guide | lines to improv | e warfighter perf | ormance for | | 8.916 | 7.383 | 3.885 | |
| (U) <u>C. Other Program Funding Sum</u> (U) PE 0602102F, Materials. PE 0602202F, Human Effectiveness Applied Research. (U) PE 0603112F, Advanced Materials for Weapon Systems. (U) PE 0603319F, Airborne Laser Program. (U) PE 0604706F, Life Support Systems. (U) <u>D. Acquisition Strategy</u> Not Applicable. | mary (\$ in Milli FY 2003 Actual | ons) FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 20 Estin | | <u>Total Cost</u> | |
| Project 5020 | | R- | | Item No. 21-21 of 2 359 | 21-21 | | | Exhibit R-2a (| PE 0603231F | |

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PE NUMBER: 0603270F PE TITLE: Electronic Combat Technology

| | it R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 | | | | |
|---|-------------------------------|--------------------------------------|------------------------------------|------------------------------------|-------------------------------------|---|---|--|--|--|--|--|--|
| DGET ACTIVITY PE NUMBER AND TITLE Advanced Technology Development (ATD) 0603270F Electronic Combat Technology | | | | | | | | | | | | | |
| | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | | | | |
| Cost (\$ in Millions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | | | | |
| Total Program Element (PE) Cost | 24.000 | 34.597 | 28.282 | 26.555 | 26.318 | 26.759 | 27.189 | Continuing | Continui | | | | |
| 2432 Defensive System Fusion Technology | 7.766 | 8.017 | 7.657 | 5.872 | 5.357 | 5.447 | 5.534 | Continuing | Continui | | | | |
| 31G RF Warning & Countermeasures Tech | 5.727 | 11.846 | 8.265 | 8.636 | 8.709 | 8.856 | 8.998 | Continuing | Continui | | | | |
| 591X EO/IR Warning & Countermeasures Tech | 10.507 | 14.734 | 12.360 | 12.047 | 12.252 | 12.456 | 12.657 | Continuing | Continui | | | | |
| subsystems, and technologies with potentia demonstrates techniques and technologies advanced technologies for radio frequency electro-optical, infrared, and laser threats t | for integrating EC suites. Th | EC sensors and e third project of | d systems into a develops and d | a fused and seat emonstrates ad | mless whole. T | The second proj g and counterm | ect develops and easure technol | nd demonstrates ogies to defeat | S | | | | |
| Program and \$2.5 million for Detect and A technologies for existing system upgrades | void for UAV. | . This program | is in Budget A | ctivity 3, Adva | anced Technolo | ogy Developme | nt, since it dev | | | | | | |
| Program and \$2.5 million for Detect and A | and/or new sen | . This program | is in Budget A | ctivity 3, Adva | nced Technolo nilitary utility a | ogy Developmer and address war | nt, since it dev fighter needs. | elops and demo | onstrates | | | | |
| Program and \$2.5 million for Detect and A technologies for existing system upgrades U) B. Program Change Summary (\$ in Mill | and/or new sen | . This program | is in Budget A | ctivity 3, Adva | nced Technolo nilitary utility a | nd address war FY 2003 | nt, since it deve fighter needs. | elops and demo | Instrates <u>FY 2005</u> | | | | |
| Program and \$2.5 million for Detect and A technologies for existing system upgrades U) B. Program Change Summary (\$ in Mill U) Previous President's Budget | and/or new sen | . This program | is in Budget A | ctivity 3, Adva | nced Technolo nilitary utility a | by Developmer and address war <u>FY 2003</u> 23.828 | nt, since it deve fighter needs. <u>FY 2</u> 28 | elops and demo 2004 .496 | nstrates <u>FY 2005</u> 28.356 | | | | |
| Program and \$2.5 million for Detect and A technologies for existing system upgrades U) <u>B. Program Change Summary (\$ in Mill</u> U) Previous President's Budget U) Current PBR/President's Budget | and/or new sen | . This program | is in Budget A | ctivity 3, Adva | nced Technolo nilitary utility a | by Development and address war <u>FY 2003</u> 23.828 24.000 | nt, since it deve fighter needs. <u>FY 2</u> 8 34 | 2004 .496 .597 | onstrates | | | | |
| Program and \$2.5 million for Detect and A technologies for existing system upgrades U) B. Program Change Summary (\$ in Mill U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments | and/or new sen | . This program | is in Budget A | ctivity 3, Adva | nced Technolo nilitary utility a | by Developmer and address war <u>FY 2003</u> 23.828 | nt, since it deve fighter needs. <u>FY 2</u> 28 34 | elops and demo 2004 .496 | nstrates <u>FY 2005</u> 28.356 | | | | |
| Program and \$2.5 million for Detect and A technologies for existing system upgrades U) B. Program Change Summary (\$ in Mill U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments | and/or new sen | . This program | is in Budget A | ctivity 3, Adva | nced Technolo nilitary utility a | by Development and address war <u>FY 2003</u> 23.828 24.000 | nt, since it deve fighter needs. <u>FY 28</u> 34 6 -0 | 2004 .496 .101 | nstrates <u>FY 2005</u> 28.356 | | | | |
| Program and \$2.5 million for Detect and A technologies for existing system upgrades U) B. Program Change Summary (\$ in Mill U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments U) Congressional Program Reductions | and/or new sen | . This program | is in Budget A | ctivity 3, Adva | nced Technolo nilitary utility a | by Development and address war <u>FY 2003</u> 23.828 24.000 | nt, since it deve fighter needs. <u>FY 2</u> 8 34 6 -0 -0 -0 | 2004 .496 .597 .101 .003 | nstrates <u>FY 2005</u> 28.356 | | | | |
| Program and \$2.5 million for Detect and A technologies for existing system upgrades U) B. Program Change Summary (\$ in Mill U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments U) Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings | and/or new sen | . This program | is in Budget A | ctivity 3, Adva | nced Technolo nilitary utility a | by Development and address war <u>FY 2003</u> 23.828 24.000 | nt, since it deve fighter needs. <u>FY 2</u> 8 34 6 -0 -0 -0 | 2004 .496 .597 .101 .003 .296 | nstrates <u>FY 2005</u> 28.356 | | | | |
| Program and \$2.5 million for Detect and A technologies for existing system upgrades U) B. Program Change Summary (\$ in Mill U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments U) Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings SBIR/STTR Transfer | and/or new sen | . This program | is in Budget A | ctivity 3, Adva | nced Technolo nilitary utility a | by Development and address war <u>FY 2003</u> 23.828 24.000 0.172 | nt, since it deve fighter needs. <u>FY 2</u> 8 34 6 -0 -0 -0 | 2004 .496 .597 .101 .003 .296 | nstrates <u>FY 2005</u> 28.356 | | | | |
| Program and \$2.5 million for Detect and A technologies for existing system upgrades B. Program Change Summary (\$ in Mill U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments U) Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings SBIR/STTR Transfer U) Significant Program Changes: | and/or new sen | . This program | is in Budget A | ctivity 3, Adva | nced Technolo nilitary utility a | by Development and address war <u>FY 2003</u> 23.828 24.000 0.172 0.673 | nt, since it deve fighter needs. <u>FY 2</u> 8 34 6 -0 -0 -0 | 2004 .496 .597 .101 .003 .296 | nstrates <u>FY 2005</u> 28.356 | | | | |
| Program and \$2.5 million for Detect and A technologies for existing system upgrades U) B. Program Change Summary (\$ in Mill U) Previous President's Budget U) Current PBR/President's Budget U) Total Adjustments U) Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings SBIR/STTR Transfer | and/or new sen | . This program asor and EC sys | is in Budget A | activity 3, Adva | nced Technolo nilitary utility a | by Development and address war <u>FY 2003</u> 23.828 24.000 0.172 0.673 | nt, since it deve fighter needs. <u>FY 2</u> 8 34 6 -0 -0 -0 | 2004 .496 .597 .101 .003 .296 | nstrates <u>FY 2005</u> 28.356 28.282 | | | | |

| | Exh | nibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 | |
|--|--|--|--|--|--|---|----------------------------------|--|------------------------------------|-------------------------|--|
| | ET ACTIVITY dvanced Technology Development (/ | ATD) | | | PE NUMBER AND 0603270F Elec Fechnology | | pat | PROJECT NUMBER AND TITLE 2432 Defensive System Fusion Technology | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | |
| 2432 | | 7.766 | 8.017 | 7.657 | 5.872 | 5.357 | 5.447 | | Continuing | Continuing | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| (U) | A. Mission Description and Budget Item This project develops and demonstrates te assessment techniques needed to evaluate required for command and control (C2) we operations. Technologies included are: and collection methods to inform field comma | chnologies for i and enable com arfare, standoff dvanced compo | bat aircraft op jamming, and nents and tech | erations in mu electronic sup niques needed | lti-spectral threa port measures fo to jam enemy r | at and countern or the denial, d | neasure enviro isruption, and | onments. It also suppression of a | matures techno adversary air de | efense | |
| (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 | B. Accomplishments/Planned Program (S MAJOR THRUST: Develop and investiga hostile command and control nodes and net In FY 2003: Completed hardware and soft electronic attack and electronic support mea systems. Continued detailed planning for the selection of the most viable threat. Designed wideband data link targets. In FY 2004: Finalize the detailed flight tess Electronic Attack/Electronic Support (EA/I navigation systems. Document system desi software for the EA/ES system to counter h ground-based and airborne platforms. Fabr In FY 2005: Integrate and demonstrate flya high-speed, wideband data and communica | te offensive cou works. ware system int asures techniqu he flight tests. ed effective cou t plan, based on ES) countermea ign and ground/ high-speed, wide cicate hardware a | egration, and c es to counter a Investigated an ntermeasure te the results of sures system to flight test resu eband data/con to process and nd software fo | conducted exter dversarial com ad analyzed va chniques again the exhaustive o counter adve lts in a final re munication li attack the thre r the EA/ES su | ensive ground te munication and rious computer nst selected high ground tests. F rsary communic port. Design ha nks utilized by eat network. upport system to | sts to evaluate I navigation networks for h-speed, Flight test the cation and ardware and multiple | E | <u>7 2003</u> 3.236 | <u>FY 2004</u> 3.394 | <u>FY 2005</u> 2.975 | |
| (U)] 1 (U)] | MAJOR THRUST: Develop and integrate In FY 2003: Conducted risk reduction eval Applications Laboratory (IDAL) that focus reduction evaluations and demonstrations to real-time threat situational awareness. In FY 2004: Conduct evaluations and risk set 2432 | luations and der ed these techno o evolve advand | nonstrations in logies on missi ced sensor three nstrations of d | the Integrated ion application at identificatio efensive senso | d Demonstration as. Conducted I on and location a | DAL risk algorithms for n of multiple | | 2.232 | 1.805 Exhibit R-2a (I | 2.045 PE 0603270F) | |
| | | | | 26 | | | | | | | |

| | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | DATE | February | 2004 |
|--|---|--|---|---|-----------------------------------|-----------------------------------|--|----------------------------|--------------|
| BUDGET ACTIVITY 03 Advanced Technology Develop | ment (ATD) | | | PE NUMBER A 0603270F E Technology | lectronic Com | nbat | PROJECT NUME 2432 Defensi Technology | usion | |
| information sources for situational a evaluations and demonstrations that(U) In FY 2005: Continue conducting e | t evolve and opti evaluations and r | mize sensor fusi isk reduction de | on algorithms. | defensive senso | rs and fusion of | | | | |
| multiple information sources for sit (IDAL). Continue conducting IDA optimize sensor fusion algorithms f awareness. Conduct IDAL laborate | L laboratory risl or utilization on | c reduction evalution evalution the second sec | uations and demonstrations and remove that provide re | onstrations that al-time threat si | evolve and ituational | | | | |
| processor technologies that provide current and next generation aerospa | - | vith multispectra | ll warning, identi | fication, and th | reat response for | | | | |
| (U)(U) MAJOR THRUST: Develop afford techniques. | lable radio freque | ency (RF) and e | lectro-optical (E | O) emitter warn | ing concepts and | 1 | 2.298 | 2.818 | 2.637 |
| (U) In FY 2003: Developed affordable increase survivability against advan analyses for techniques to defeat fu development through subsystem tes capability. | ced, integrated F ture threat radar- | RF, EO, and infr guided missile s | ared air defense systems. Continu | systems, includiued hardware ar | ing trade study id software | | | | |
| (U) In FY 2004: Continue developing a aircraft to increase survivability aga trade study analyses for techniques tests, and laboratory demonstrations | iinst advanced, ii to defeat future t | ntegrated RF, E0 hreat radar guid | O, and infrared a ed missile syster | ir defense system ns. Complete s | ms, including | | | | |
| (U) In FY 2005: Demonstrate affordab to increase survivability against adv implementation of techniques to de techniques into plans for flight dem capability. Develop advanced proc | le threat alert and vanced, integrated feat future threat onstrations of a s | l jamming techn d RF, EO, and in radar guided mi significantly imp | iques generator nfrared air defens issile systems. In proved digital thr | technologies for se systems, inclu- ncorporate adva reat warning and | uding nced jamming | | | | |
| (U) Total Cost | | | •••••• | - Signalsi | | | 7.766 | 8.017 | 7.657 |
| (U) <u>C. Other Program Funding Sum</u> | <u>mary (\$ in Milli</u> <u>FY 2003</u> <u>Actual</u> | <u>ons)</u> <u>FY 2004</u> Estimate | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> Estimate | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> Complete | Total Cost |
| (U) Related Activities: (U) PE 0602204F, Aerospace Sensors. | Actual | | | | | Estimate | Lsumate | Complete | |
| Project 2432 | | R | -1 Shopping List - | Item No. 22-4 of 2 363 | 22-11 | | | Exhibit R-2a (| PE 0603270F) |

| Exhibit R-2a, RDT&E P | roject Justification | | DATE February 2004 | | |
|--|---|--------|---|--|--|
| BUDGET ACTIVITY 33 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603270F Electronic Combat Technology | 2432 C | ECT NUMBER AND TITLE Defensive System Fusion nology | | |
| U C. Other Program Funding Summary (\$ in Millions) PE 0603203F, Advanced Aerospace Sensors. PE 0603500F, U) Multi-disciplinary Advanced Space Technology. PE 0604270F, Electronic Warfare (EW) Development. This project has been coordinated through the U) Reliance process to harmonize efforts and eliminate duplication. U D. Acquisition Strategy Not Applicable. | | | | | |
| Project 2432 R-1 | Shopping List - Item No. 22-5 of 22-11 | | Exhibit R-2a (PE 0603270 | | |

| | Exh | ibit R-2a, F | RDT&E Pro | ject Justif | fication | | | DATE | February | 2004 | |
|--|---|--|--|--|---|---|--|--|---|-------------------------|--|
| | ET ACTIVITY Ivanced Technology Development (/ | ATD) | | | PE NUMBER AND 0603270F Elec Technology | | at | 431G RF Wa | CT NUMBER AND TITLE RF Warning & termeasures Tech | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | |
| 431G | | 5.727 | 11.846 | 8.265 | | 8.709 | 8.856 | | Continuing | Continuing | |
| | Quantity of RDT&E Articles In FY 2003, space unique tasks in this pro | 0 | 0 | 0 | | 0 | 0 | Ŷ | | | |
| space | A. Mission Description and Budget Item This project develops and demonstrates ad and to provide crew situational awareness. sorting/preprocessing algorithms, and expe demonstration of subsystems and compone countermeasures (ECM) techniques as we | 1 Justification lvanced techno . One major are ert software for ents for generat | logies for radic ea addresses te applications o ing on-board/c | o frequency (R chnologies for n existing and off-board RF c | F) electronic con missile/threat w future EC syste ountermeasure t | mbat (EC) suite varning, RF rec ms. Another m echniques. Thi | es to enhance t eivers, EC pre najor technolog s includes the | he survivability processors, adv gy area focuses | of aerospace v vanced on the develops | rehicles | |
| (U) M (U) H a b (U) H in (U) H it to | 8. Accomplishments/Planned Program (S MAJOR THRUST: Develop wideband, much reat detection, threat avoidance, suppression n FY 2003: Demonstrated proof-of-concept rrays that are integrated into potential unmer colarization elements and perform over an ele- tetween 4:1 to 10:1. n FY 2004: Fully characterize adaptive, we noto future unmanned aerial vehicle aperture n FY 2005: Develop low-cost wideband a echniques. | alti-mode, mult ion of enemy ai pt for cost and anned aerospace extremely wide rideband, confo e and receiver of | ir defenses, sur weight reduction ce platforms. The frequency rand rmal phased ar concepts to ass | veillance, and on for adaptive hese subarrays ge with an inst rays that have ess technology | reconnaissance) e, wideband cont s will have mult tantaneous band been structurall y readiness level | formal phased iple width of y integrated s. | <u>F</u> } | <u>7 2003</u> 1.828 | <u>FY 2004</u> 2.040 | <u>FY 2005</u> 3.315 | |
| C (U) In a d s | AJOR THRUST: Develop aerospace pla ounter advanced RF threats associated with n FY 2003: Completed study of and contin- upport jamming technologies and technique erospace weapon systems. Initiated develo- eveloping and evaluating innovative RF co- ystems. Continued developing and perform echniques and technology to protect aerosp | h current and finued developin tes to counter a oping next gene ountermeasure ming laboratory | ature aerospace g and demonst dvanced RF th eration monoputechniques for y and field tests | e weapon syste rating aerospac reats associate ilse counterme aerospace plat | ems. ce platform self- ed with current a easure systems. tforms against fu | protection and nd future Continued uture RF threat | | 3.899 | 5.906 | 4.950 | |
| Proje | ct 431G | | <u>R-1</u> Sh | opping List - Iter | m No. 22-6 of 22-1 | 1 | | | Exhibit R-2a (I | PE 0603270F) | |
| | | | | 36 | | | | | | | |

| | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | DATE | February | 2004 |
|--|--|--|---|---|---|-----------------------------------|---|-----------------------------------|-------------------|
| BUDGET ACTIVITY 03 Advanced Technology Develop | oment (ATD) | | | PE NUMBER A 0603270F E Technology | lectronic Com | ıbat | PROJECT NUM 431G RF Wa Countermea | BER AND TITLE | |
| (U) In FY 2004: Continue developing, Force aerospace platforms. Perform platforms against future radio frequent techniques in advanced radar syste (U) In FY 2005: Develop self-protection systems. Conduct laboratory evalue Continue laboratory and field-testing engagement radars. Develop anti-j | m laboratory testi uency (RF) threat ms. Laboratory a on countermeasur nations of counter ng of innovative, | ng of innovative systems. Contin nd field test thes res effective again measures to defe networked RF c | RF countermeating in the developing is the techniques. The techniques is the techniques is the for fourth get an advanced ountermeasure to the technique tec | sure techniques nnovative electr eneration surface integrated air de echniques agains | for aerospace onic protection e to air missile fense system. | | | | |
| (U) (U) CONGRESSIONAL ADD: Advar (U) In FY 2003: Not Applicable. (U) In FY 2004: Design, fabricate, and software-reconfigurable digital rec controller, and integrated RF transf (U) In FY 2005: Not Applicable. | d test technologies eivers and proces | s to support an e sors, counterme | nd-to-end suppo asures technique | rt jammer syster | n with | | 0.000 | 3.400 | 0.000 |
| (U) (U) CONGRESSIONAL ADD: Receiv (U) In FY 2003: Not Applicable. (U) In FY 2004: Expand research in admodern technologies. | | | - | | art concepts and | I | 0.000 | 0.500 | 0.000 |
| (U) In FY 2005: Not Applicable.(U) Total Cost | | | | | | | 5.727 | 11.846 | 8.265 |
| (U) <u>C. Other Program Funding Sum</u> (U) Related Activities: PE 0602204F, Aerospace Sensors. (U) PE 0604270F, Electronic Warfare (EW) Development. PE 0603500F, (U) Multi-disciplinary Advanced Sensor Technology | <u>mary (\$ in Milli</u> <u>FY 2003</u> <u>Actual</u> | ons) FY 2004 Estimate | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | FY 2009 Estimate | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| Space Technology. Project 431G | | | -1 Shopping List - | | - <i></i> | | | | PE 0603270F) |

| Exhibit R-2a, RDT&E Pr | oject Justification | | DATE | | |
|--|---|--------|--|--|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603270F Electronic Combat Technology | 431G R | February 2004 INUMBER AND TITLE F Warning & rmeasures Tech | | |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> DE 0604270N, EW Development. This project has been coordinated through the U) Reliance process to harmonize efforts and eliminate duplication. U) <u>D. Acquisition Strategy</u> Not Applicable. | Technology | Counte | rmeasures Tech | | |
| | | | | | |
| Project 431G R-1 S | hopping List - Item No. 22-8 of 22-11 | | Exhibit R-2a (PE 0603270 | | |

| Ext | nibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|---|---|---|---|--|--|---------------------|--|-------------------------|-------------------------|
| BUDGET ACTIVITY 03 Advanced Technology Development (| ATD) | | 0 | E NUMBER AND 603270F Elec echnology | TITLE | at | PROJECT NUME 691X EO/IR V Countermea | Varning & | |
| Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| 691X EO/IR Warning & Countermeasures Tech | 10.507 | 14.734 | 12.360 | 12.047 | 12.252 | 12.456 | | Continuing | Continuing |
| Quantity of RDT&E Articles Note: In FY 2003, space unique tasks in this pro- | 0 | 0 | 0 | 0 | 0 | 0 | - | | |
| space unique tasks. (U) <u>A. Mission Description and Budget Iter</u> This project develops and demonstrates th aerospace platforms. Off-board (decoys a solutions for protection against IR missile and radar-guided missiles. | ne advanced war and expendables | s) and on-board | l countermeasu | re technologies | developed for | aircraft self-p | rotection will pr | ovide robust, at | ffordable |
| (U) <u>B. Accomplishments/Planned Program (</u> (U) MAJOR THRUST: Develop on-board, clocurrent and future IR-guided missiles in mi (U) In FY 2003: Completed flight tests of closs (U) In FY 2004: Not Applicable. Work compi (U) In FY 2005: Not Applicable. (U) | osed-loop, laser ultiple scenarios ed-loop IRCM | 5. | | CM) for large a | ircraft to defea | | <u>7 2003</u> 0.320 | <u>FY 2004</u> 0.000 | <u>FY 2005</u> 0.000 |
| (U) MAJOR THRUST: Analyze the vulnerabi (U) In FY 2003: Conducted in-house analyses sensors. Fabricated an expendable decoy t at low altitudes over urban areas. Acquired for target acquisition. (U) In FY 2004: Continue conducting in-house missiles. Demonstrate and evaluate counter used for target acquisition. Initiate develop (U) In FY 2005: Continue conducting in-house | of the vulnerab echnology suita d and assessed c e analyses on vu ermeasure techn ping low-cost, c e analyses on cu | ilities of curren ble for peaceko apabilities and ilnerabilities of iques for count ooperative tech urrent IR-guide | nt IR missile sy eeping operatio l vulnerabilities f current and fu tering multiple nniques to cour d missile susce | stems and future of imaging IR iture IR imaging types of imaging tret imaging IR eptibilities and f | re imaging IR safely deployed sensors used g sensors and ng IR sensors sensors. Future imaging | | 1.822 | 2.282 | 2.386 |
| IR sensors. Continue evaluation of counter used for target acquisition. Initiate develop Continue designing and begin developing of properties that can be used to deceive imag | ping low-cost, c expendable deco | ooperative tech | nniques to cour | nter imaging IR | sensors. | | | | |
| Project 691X | | R-1 Sh | | n No. 22-9 of 22-1 | 1 | | | Exhibit R-2a (I | PE 0603270F) |
| | | | 368 | } | | | | | |

| Exhibit R-2a, RDT&E Pr | oject Justification | DA | February | 2004 |
|--|--|------------|--|--------------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603270F Electronic Combat Technology | 691X EO/IF | IMBER AND TITLE R Warning & easures Tech | |
| (U) (U) MAJOR THRUST: Develop aerospace laser warning sensor technologi acquisition/tracking sensors, including detecting and locating both high (laser-guided ordnance) signals. (U) In FY 2003: Initiated design of an airborne laser warning sensor which sensor protection. (U) In FY 2004: Complete design of an airborne laser warning sensor that c sensor protection. Conduct laboratory demonstration of cueing capabili sensor capable of identifying and classifying battlefield lasers that are data (U) In FY 2005: Initiate risk reduction research and development for contin remote vehicles and sensors. Initiate development of advanced eye and | power (dazzle/damage) and low power can cue agile filter protection for aircrew or can cue agile filter protection for aircrew or ties. Test and demonstrate a multi-platform angerous to eyes and sensors. nuous wave and femto-second lasers from | 3.166 | 4.219 | 4.036 |
| (U) (U) MAJOR THRUST: Develop a countermeasure technology to defeat pasaircraft tracking sensors and ordnance guidance. (U) In FY 2003: Initiated an advanced technology demonstration program t tracking sensors. Completed preliminary design for a method to counter p boundaries. Complete assessment of multiple threats and threat surroga (U) In FY 2005: Demonstrate laboratory capability to locate and counter pasairc | ssive electro-optical (EO) and infrared (IR) to detect and counter passive EO and IR r sensors beyond kinematic launch capability. passive threats beyond kinematic launch tes. Initiate developing a laboratory testbed. | 4.257 | 4.623 | 4.709 |
| control solution. Initiate fabricating a testbed for field demonstrations of (U) (U) MAJOR THRUST: Develop EO/IR missile warning technologies to all to the approach of advanced, low-signature threats. (U) In FY 2003: Not Applicable. (U) In FY 2004: Establish spatial, spectral, and temporal trade space for add detecting low contrast missile threats in high clutter backgrounds. Performed to the spectral spe | over extended ranges. ert aircrews and aircraft self-protection systems vanced missile warning sensors optimized for | 0.000 | 1.110 | 1.229 |
| performance. (U) In FY 2005: Perform a concept evaluation of a visible band passive was countermeasure initiation with high declaration probability and low false. (U) (U) CONGRESSIONAL ADD: Detect and Avoid for UAV. Note: In FY 2 Technology for FAA. (U) In FY 2003: Developed and demonstrated an interim "see and avoid" systematical evaluation of the systema | e alarm rate. 003, this Add was titled Test Detect and Avoid | 0.942 | 2.500 | 0.000 |
| | nopping List - Item No. 22-10 of 22-11 | | Exhibit R-2a (F | PE 0603270F) |

| | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | DATE | February | 2004 |
|--|---|-----------------------------|-----------------------------------|---|-----------------------------------|-----------------------------------|---|-----------------------------------|-------------------|
| BUDGET ACTIVITY 03 Advanced Technology Develo | pment (ATD) | | | PE NUMBER A 0603270F E Technology | lectronic Com | ıbat | PROJECT NUME 691X EO/IR V Countermeas | BER AND TITLE | |
| with Federal Aviation Administrat (U) In FY 2004: Implement an interin Aviation Administration approval (U) In FY 2005: Not Applicable. (U) Total Cost | n "see and avoid" | system for unma | nned aerial vehi | icles that meets v | | | 10.507 | 14.734 | 12.360 |
| (U) C. Other Program Funding Sum (U) Related Activities: PE 0602204F, Aerospace Sensors. (U) PE 0604270F, Electronic (U) Warfare (EW) Development. PE 0603500F, (U) Multi-disciplinary Advanced Development Space Technology. (U) Development. PE 0604270N, EW Development. (U) Development. PE 0603203F, Advanced Aerospace Sensors. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) D. Acquisition Strategy | nmary (\$ in Milli <u>FY 2003</u> <u>Actual</u> | ons) FY 2004 Estimate | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> Estimate | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| Not Applicable. Project 691X | | | 1 Shopping List - I | tem No. 22-11 of 2 | 22-11 | | | Exhibit R-2a | PE 06032701 |

PE NUMBER: 0603311F PE TITLE: Ballistic Missile Technology

| | Exhib | oit R-2, RD1 | &E Budge | t Item Just | tification | | | DATE | Februarv | 2004 | |
|--|---|---|-------------------------------------|------------------------------------|---------------------------------|-----------------|---|--------------|----------------|----------------|--|
| BUDGET ACTIVITY PE NUMBER AND TITLE 03 Advanced Technology Development (ATD) FY 2003 FY 2004 FY 2005 FY 2006 FY 2007 FY 2008 FY 2009 Cost to Cost to Cost (\$ in Millions) FY 2003 Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Cost to Cost to Complete Total Program Element (PE) Cost 12.795 11.402 0.000 <t< th=""></t<> | | | | | | | | | | | |
| DATE Exhibit R-2, RDT&E Budget Item Justification DATE February 2004 BUDGET ACTIVITY 03 Advanced Technology Development (ATD) February 2004 FY 2006 FY 2007 FY 2008 FY 2008 FY 2007 FY 2008 FY 2008 FY 2009 Cost to Total Program Element (PE) Cost 12.795 11.402 0.000 0.000 Cost to Total Program Element (PE) Cost 12.795 11.402 0.000 Complet The 0.000 Complet Tota <th c<="" th=""><th>Total</th></th> | | | | | | | | | <th>Total</th> | Total | |
| | × , , , , , , , , , , , , , , , , , , , | | | | | | | | | | |
| | | | | | | | | | | TE | |
| | | | | | | | | | 0.000 | TI | |
| J) | This program develops, integrates, and de for range safety instrumentation. Note: In (CAV), Small Launch Vehicle (SLV), Min | monstrates adva n FY 2004, Cor nuteman III (M | gress added \$8 MIII) Critical 7 | 5.5 million for l Fechnology De | Ballistic Missile velopment. | es Technology | and \$3.0 million | n for Common | Aerospace Vel | nicle | |
| IJ) | system developments that have military ut | tility and addres | ••• | | verops and dem | | - | | - | | |
| n | | | | | | | | | | <u>FY 2005</u> | |
| <i>′</i> | 6 | | | | | | | | | 0.000 | |
| <u></u> | | | | | | | | | | 0.000 | |
| · | 5 | | | | | | -0.304 | 11 | .402 | | |
| ' | | | | | | | | -0 | 098 | | |
| | • | | | | | | | | | | |
| | • | | | | | | | 11 | .500 | | |
| | | | | | | | -0.364 | | | | |
| D | | | | | | | 0.001 | | | | |
| ' | | program. How | ever. Congress | has added fun | ds for special ir | terest projects | since FY 1997. | | | | |
| | In 191 1997, the An Porce eminiated uns | program. How | ever, Congress | has added fund | us for special in | nerest projects | since 1 [°] 1 [°] 1997. | | | | |
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| | | | | | | | | | | | |
| | | | | | | | | | | | |

| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) PENLMBER AND TTLE 06033171F Ballistic Missile Cost (\$ in Millions) Actual Fatimate Fatima | | Ex | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|--|------------|---|---|--|--|--|---|------------------|---------------|---|--------------|
| Cost (S in Millions) Actual Estimate Estimate Estimate Estimate Estimate Complete 4091 Missile Filectronics 12.795 11.402 0.000 <td< th=""><th></th><th></th><th>(ATD)</th><th></th><th>c</th><th>0603311F Ball</th><th></th><th></th><th></th><th></th><th></th></td<> | | | (ATD) | | c | 0603311F Ball | | | | | |
| Actual Estimate < | | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| Quantity of RDT&E. Articles 0< | | | | | | | | | | ~ | |
| (I) A. Mission Description and Budget Item Justification This program develops, integrates, and demonstrates advanced guidance, navigation, and control technologies for ballistic missiles, including upgrades of instrumentation for range safety instrumentation. Note: In FY 2004, Congress added \$8.5 million for Ballistic Missiles Technology and \$3.0 million for Common Aerospace Vehicle (CAV), Small Launch Vehicle (SLV), Minuteman III (MMIII) Critical Technology Development. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs. (I) B. Accomplishments/Planned Program (5 in Millions) (I) CONGRESSIONAL ADD: Ballistic Missile Technology, Advanced Guidance Technologies for Ballistic Missiles | 4091 | | | | | | | | | 0.000 | TBD |
| This program develops, integrates, and demonstrates advanced guidance, navigation, and control technologies for ballistic missiles, including upgrades of instrumentation for range safety instrumentation. Note: In FY 2004, Congress added \$8.5 million for Ballistic Missiles Technology and \$3.0 million for Common Aerospace Vehicle (CAV), Small Launch Vehicle (SLV), Minuteman III (MMIII) Critical Technology Development. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs. (U) B. Accomplishments/Planned Program (S in Millions) FY 2003 FY 2004 FY 2005 (U) CONGRESSIONAL ADD: Ballistic Missile Technology, Advanced Guidance Technologies of Ballistic Missiles 11.351 0.000 0.000 (U) In FY 2003: Developed, integrated, and demonstrated advanced guidance technologies with the associated radiation hardenable electronics and flight computers required for future strategic missile applications. Developed, validated, and certified advanced vehicle structures and designs for improved ballistic missile guidance and control. Developed and demonstrated sustainable technologies and material sources capable of reducing vehicle cost while increasing robustness, maintainability, and controllability to meet the unique requirements of the advanced Multine missile. 1.444 0.000 0.000 (U) In FY 2003: Not Applicable. 1.444 0.000 0.000 (U) In FY 2003: Not Applicable. | | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| U. B. Accomplishments/Planned Program (5 in Millions) FY 2003 FY 2004 FY 2005 (U) CONGRESSIONAL ADD: Ballistic Missile Technology, Advanced Guidance Technologies for Ballistic Missiles 11.351 0.000 0.000 (U) In FY 2003: Developed, integrated, and demonstrated advanced guidance technologies with the associated radiation hardenable electronics and flight computers required for future strategic missile applications. Developed, validated, and certified advanced, mobile range safety instrumentation extending prompt missile launch capabilities to existing and future range sensors. Developed advanced valice structures and designs for improved ballistic missile guidance and control. Developed and demonstrated sustainable technologies and material sources capable of reducing vehicle cost while increasing robustness, maintainability, and controllability to meet the unique requirements of the advanced ballistic missile 11.444 0.000 0.000 (U) In FY 2003: Not Applicable. 11.444 0.000 0.000 (U) UO CONGRESSIONAL ADD: Ballistic Missile Technology, Common Guidance Development Program of Sensor 1.444 0.000 0.000 (U) UO FY 2003: Developed advanced sensor technologies needed to meet accuracy requirements, to extend range, to reduce maintenance costs, and to lengthen mean time between failures. 1.444 0.000 0.000 (U) In FY 2005: Not Applicable. 1.444 0.000 0.000 (U) In FY 2005: Not Appl | (U) | This program develops, integrates, and d for range safety instrumentation. Note: (CAV), Small Launch Vehicle (SLV), M This program is in Budget Activity 3, Ac | emonstrates adva In FY 2004, Con inuteman III (M lvanced Technology | gress added \$8 MIII) Critical 7 ogy Developm | 3.5 million for Fechnology De ent, since it de | Ballistic Missile evelopment. | es Technology | and \$3.0 millio | on for Common | Aerospace Veh | nicle |
| that sustain current strategic missile systems. Developed new accelerometer technologies with the associated radiation hardenable electronics and flight computers required for future strategic missile applications. Developed, validated, and certified advanced, mobile range safety instrumentation extending prompt missile launch capabilities to existing and future range sensors. Developed advanced vehicle structures and designs for improved ballistic missile guidance and control. Developed and demonstrated sustainable technologies and material sources capable of reducing vehicle cost while increasing robustness, maintainability, and controllability to meet the unique requirements of the advanced ballistic missile mission. (U) In FY 2004: Not Applicable. (U) (U) CONGRESSIONAL ADD: Ballistic Missile Technology, Common Guidance Development Program of Sensor 1.444 0.000 0.000 Technologies. (U) In FY 2003: Developed advanced sensor technologies that are accurate and robust enough to provide the next generation of guidance instrumentation required for a broad range of future ballistic missiles. Identified the critical technical elements and component technologies needed to meet accuracy requirements, to extend range, to reduce maintenance costs, and to lengthen mean time between failures. (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. (U) In FY 2005: Not Applicable. | (U) | B. Accomplishments/Planned Program CONGRESSIONAL ADD: Ballistic Mis | (\$ in Millions) | | | logies for Ballis | stic Missiles | | | | |
| (U) In FY 2005: Not Applicable. (U) (U) CONGRESSIONAL ADD: Ballistic Missile Technology, Common Guidance Development Program of Sensor (I) In FY 2003: Developed advanced sensor technologies that are accurate and robust enough to provide the next generation of guidance instrumentation required for a broad range of future ballistic missiles. Identified the critical technical elements and component technologies needed to meet accuracy requirements, to extend range, to reduce maintenance costs, and to lengthen mean time between failures. (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. Project 4091 R-1 Shopping List - Item No. 23-2 of 23-4 Exhibit R-2a (PE 0603311F) | | that sustain current strategic missile system radiation hardenable electronics and flight validated, and certified advanced, mobile existing and future range sensors. Develo guidance and control. Developed and den reducing vehicle cost while increasing rob of the advanced ballistic missile mission. | ns. Developed r computers requirange safety instr ped advanced ve nonstrated sustain | new accelerome ired for future a rumentation ex hicle structures nable technolog | eter technologi strategic missi tending promp s and designs f gies and mater | ies with the asso le applications. pt missile launch for improved ba rial sources capa | Developed, Developed, a capabilities to llistic missile able of | | | | |
| (U) In FY 2003: Developed advanced sensor technologies that are accurate and robust enough to provide the next generation of guidance instrumentation required for a broad range of future ballistic missiles. Identified the critical technical elements and component technologies needed to meet accuracy requirements, to extend range, to reduce maintenance costs, and to lengthen mean time between failures. (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. Project 4091 R-1 Shopping List - Item No. 23-2 of 23-4 Exhibit R-2a (PE 0603311F) | (U) (U) | In FY 2005: Not Applicable. | sile Technology, | Common Guid | lance Develop | oment Program o | of Sensor | | 1.444 | 0.000 | 0.000 |
| (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. Project 4091 R-1 Shopping List - Item No. 23-2 of 23-4 Exhibit R-2a (PE 0603311F) | (U) | In FY 2003: Developed advanced sensor generation of guidance instrumentation re technical elements and component techno | quired for a broa logies needed to | d range of futu meet accuracy | re ballistic mis | ssiles. Identifie | d the critical | | | | |
| | (U) | In FY 2004: Not Applicable. | | | | | | | | | |
| | Proj | ect 4091 | | R-1 Sł | | | 4 | | | Exhibit R-2a (F | PE 0603311F) |

| | Exhibit R | 2a RDT&F | Project Jus | | | | DATI | | |
|--|---|---|--|---|---|-----------------------------------|---------------------|-----------------------------------|-------------------|
| | | | | | | | | February | 2004 |
| BUDGET ACTIVITY 03 Advanced Technology Develo | pment (ATD) | | | PE NUMBER A 0603311F B Technology | allistic Missile | • | | BER AND TITLE Electronics | |
| (U) (U) CONGRESSIONAL ADD: Balli (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop, integrate, a safety instrumentation and guidar computer instrumentation to strate provide a robust system applicabl integrated sensors in highly flexib (U) In FY 2005: Not Applicable. | and demonstrate ba ace sensors. Extend egic radiation level e in the most dema | llistic missile te d testing of inno s. Integrate the nding missile ap | vative acceleron instruments with pplications. Den | neter, gyroscope n guidance archi | , and flight tectures that | | 0.000 | 8.428 | 0.000 |
| (U) In FY 2003. Not Applicable. (U) (U) CONGRESSIONAL ADD: Com (MMIII) Critical Technology Dev (U) In FY 2003: Not Applicable. (U) In FY 2004: Initiate ground testin for CAV control. Initiate ground testin for CAV control. Initiate ground vehicles and MMIII critical techn meeting accuracy requirements of between failures. (U) In FY 2005: Not Applicable. (U) Total Cost | velopment. ng of critical advan testing of accurate ology developmen | ced vehicle prel and robust guid t. Verify that cr | iminary hardwar lance hardware d itical elements a | re designs and st lesigned for futu nd components | tructures required re small launch are capable of | 1 | 0.000 | 2.974 | 0.000 |
| (U) <u>C. Other Program Funding Sur</u> | | an a) | | | | | 12.775 | 11.402 | 0.000 |
| (U) Related Activities: (U) PE 0602204F, Aerospace Sensors. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | FY 2005 Estimate | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | FY 2009 Estimate | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| (U) <u>D. Acquisition Strategy</u> Project 4091 | | F | R-1 Shopping List | Item No. 23-3 of 2 | 23-4 | | | Exhibit R-2a (| PE 0603311F) |

| Exhibit R-2a, RI | DT&E Project Justification | DATE February 2004 |
|---|---|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603311F Ballistic Missile Technology | PROJECT NUMBER AND TITLE 4091 Missile Electronics |
| Not Applicable. | | |
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| Project 4091 | R-1 Shopping List - Item No. 23-4 of 23-4 374 | Exhibit R-2a (PE 0603311F) |

PE NUMBER: 0603333F PE TITLE: Unmanned Air Vehicle Dev/Demo

| | Exhib | oit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 | | |
|--|--|---|----------------------------------|--------------------------------------|--|------------------|-------------------|----------------|------------------|-----------------|--|--|
| Cost (\$ in Millions) Actual Estimate Estimate Estimate Estimate Estimate Estimate Complete Total Program Element (PE) Cost 16.719 0.000 | | | | | | | | | | | | |
| | Cost (\$ in Millions) | | | | | | | | | Total | | |
| Total F | Exhibit R-2, RDT&E Budget Item Justification DATE ETACTIVITY PE NUMBER AND TITLE 0603333F Unmanned Air Vehicle Dev/Demo February 2004 Cost (\$ in Millions) FY 2003 FY 2004 FY 2005 FY 2007 FY 2008 FY 2009 Cost to Estimate Cost to Estimate Fstimate Estimate Estimate Complete To Total Program Element (PE) Cost 16.719 0.000 0.000 0.000 0.000 0.000 Continuing Unmanned Combat Air Vehicle Tech 16.719 0.000 0.000 0.000 0.000 Continuing Demo 0.000 0.000 0.000 0.000 0.000 Continuing A.Mission Description and Budget Item Justification This program will develop and demonstrate advanced unarmed, unmanned aerial vehicle (UAV) and unmanned combat air vehicle (UCAV) technologies. Flight testing performance and supportability of UAVs and UCAVs. This program is in Budget Activity 3, Advanced Development, since it develops and demonstrate stechnologies for new unarmed, unmanned aerial vehicles and UCAVs That Program Change Summary (\$ in Millions) FY 2003 FY 2004 FY 2004 Previous President's Budget 17.608 0.000 <t< td=""><td>TB</td></t<> | | TB | | | | | | | | | |
| 5067 Unmar | | 16.719 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | Continuing | TB | | |
| This progr demonstra performan This progr | ram will develop and demonstrative the integration of critical technol ince and supportability of UAVs a ram is in Budget Activity 3, Adv | te advanced una ogies, such as a and UCAVs. /anced Develop | utonomous op ment, since it c | erations, inter-v levelops and de | enicle communements technologies technologie | nications, and n | nulti-vehicle fli | ght operations | , will improve t | he | | |
| J) <u>B. Progra</u> | m Change Summary (\$ in Mil | <u>lions)</u> | | | | | | | 2004 | EX 2 005 | | |
| D Provious | Prosident's Budget | | | | | | | | | | | |
| | • | | | | | | | | | 0.000 | | |
| | | | | | | | | | | 0.000 | | |
| , 5 | | | | | | | 0.000 | Ū | | | | |
| | | | | | | | | | | | | |
| - | | | | | | | | | | | | |
| - | | | | | | | -0.329 | | | | | |
| SBIR/STT | TR Transfer | | | | | | -0.560 | | | | | |
| U) <u>Significan</u> | t Program Changes: | | | | | | | | | | | |
| In FY 200 | 4, this effort transfers into PE 00 | 504731F, Unma | nned Combat | Air Vehicle. | | | | | | | | |
| | | | | | | | | | | | | |
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| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | R-1 St | 11 2 | | 3 | | | Exhibit R-2 (F | PE 0603333F | | |
| | | | | 375 UNCLASS | | | | | | | | |

| | Ext | nibit R-2a, F | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|-------|--|--|---|------------------------------------|-----------------------------------|---------------------------|---------------------------------|------------------|----------------|-------------|
| | | ATD) | | | 0603333F Unr | | ehicle | | | Air Vehicle |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Unmanned Combat Air Vehicle Tech | | | | | Estimate | Estimate | Estimate | Complete | |
| 5067 | Demo | 16.719 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) | This program will develop and demonstrate demonstrate integration of critical technol performance and supportability of UAVs This program is in Budget Activity 3, Adv | te advanced un ogies, such as a and UCAVs. /anced Develop | utonomous op oment, since it | erations, inter- develops and d | vehicle commu lemonstrates tec | nications, and i | multi-vehicle f new unarmed, | light operations | , will improve | the |
| (U)] | B. Accomplishments/Planned Program (| \$ in Millions) | | | | | F | r 2003 | FY 2004 | FY 2005 |
| (U) | Completed development and integration of communications, and multi-vehicle flight c | critical technol | 0 1 | | - | | | 9.980 | 0.000 | 0.000 |
| 1 | goal in a Command, Control, Communicat data-rich environment as part of an integra multi-vehicle flight operations, including e | ions, Computer ed Command, scort formation | , Intelligence, S Control, and C s, collision avo | Surveillance, a ommunication | nd Reconnaissa s network. Der | nce (C4ISR) nonstrated | | 2.699 | 0.000 | 0.000 |
| | | - | - | adio frequency | technologies o | n the UCAV. | | 1.897 | 0.000 | 0.000 |
| | | | - | - | | | e | 1.095 | 0.000 | 0.000 |
| (U) | Completed integration of miniature munit | | • | | | | | 1.048 | 0.000 | 0.000 |
| | - | | | | | | | 16.719 | 0.000 | 0.000 |
| (U) | | | | | | | | | | |
| | | | | | | | | | | Total Cost |
| | PE 0602202F, Human | | | LSumate | Estimate | Estimate | Estimate | <u>Estimate</u> | Complete | |
| Proje | Pebruary 2004 Advanced Technology Development (ATD) Pe NUMBER AND TITLE 0603333F Unmanned Air Vehicle Dev/Demo PROJECT NUMBER AND TITLE 5067 Unmanned Combat Air Vehicle Tech Demo ^C Cost (\$ in Millions) FY 2003 FY 2004 FY 2006 FY 2006 FY 2008 FY 2008 FY 2008 Cost (\$ in Millions) Total ^C Cost (\$ in Millions) FY 2004 FY 2006 FY 2006 FY 2008 FY 2008 Cost (\$ in Millions) Total ^{Actual} Estimate Estimate <td< td=""><td>PE 0603333F)</td></td<> | | | PE 0603333F) | | | | | | |
| | | | | 37 | 6 | | | | | |

| 03 Ac (U) <u>(</u> (U) ¹ (U) ¹ | Exhibit R-2a, RD ET ACTIVITY Ivanced Technology Development (ATD) | PE NUMBER AND TITLE | DATE February 2004 PROJECT NUMBER AND TITLE |
|---|--|---|---|
| 03 Ac (U) <u>(</u> (U) ¹ (U) ¹ | | | |
| (U) ¹ | | 0603333F Unmanned Air Vehicle Dev/Demo | 5067 Unmanned Combat Air Vehicle Tech Demo |
| (U) 1 (U) 1 (U) 2 (U) 2 (U) 1 (U) 1 | C. Other Program Funding Summary (\$ in Millions) PE 0602201F, Aerospace Vehicle Technologies. PE 0603203F, Advanced Aerospace Sensors. PE 0603601F, Conventional Weapons. PE 0603789F, C3I Advanced Development. PE 0604731F, Unmanned Combat Air Vehicle. PE 0602702E, Tactical Technology. PE 0603285E, Advanced Aerospace Systems. PE 0603762E, Sensor and Guidance Technology. This project has been coordinated through the Reliance process to harmonize efforts and eliminate huplication. D. Acquisition Strategy Not Applicable. | Dev/Demo | Tech Demo |
| Proio | ct 5067 | R-1 Shopping List - Item No. 24-3 of 24-3 | Exhibit R-2a (PE 0603333F) |

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PE NUMBER: 0603401F PE TITLE: Advanced Spacecraft Technology

| | Exhil | bit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 |
|------|---|-------------------|---------------------|---------------------|-----------------------------|---------------------|---------------------|---------------------|---------------------|-------|
| | T ACTIVITY /anced Technology Development (| (ATD) | | | E NUMBER AND 603401F Adv | | craft Techno | logy | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| | Total Program Element (PE) Cost | 52.424 | 96.912 | 60.124 | 65.892 | 72.085 | 88.248 | 90.947 | Continuing | TBI |
| 2181 | Spacecraft Payloads | 14.633 | 22.477 | 18.013 | 18.326 | 19.780 | 36.219 | 36.223 | Continuing | TBI |
| 3834 | Integrated Space Technology Demonstrations | 13.243 | 28.693 | 18.584 | 25.057 | 27.460 | 26.531 | 26.716 | Continuing | TBI |
| 4400 | Space Systems Protection | 2.688 | 9.432 | 3.473 | 3.505 | 3.570 | 3.630 | 3.688 | Continuing | TBI |
| 4938 | Space Developmental Planning | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | TBI |
| 5021 | Space Systems Survivability | 3.878 | 4.136 | 4.775 | 4.854 | 4.982 | 5.066 | 5.147 | Continuing | TBI |
| 5083 | Ballistic Missiles Technology | 0.000 | 6.802 | 6.859 | 5.815 | 4.069 | 4.137 | 4.204 | Continuing | TBI |
| 682J | Spacecraft Vehicles | 17.982 | 25.372 | 8.420 | 8.335 | 12.224 | 12.665 | 14.969 | Continuing | TBI |

Note: In FY 2003, selected efforts in Project 4400 were transferred within this PE into Project 5021 in order to focus on improving survivability of space systems in natural environments.

(U) A. Mission Description and Budget Item Justification

This program develops, integrates, and demonstrates space technologies in the areas of spacecraft payloads, spacecraft protection, spacecraft and launch vehicles, ballistic missiles, space systems survivability, and development of advanced laser communications technologies to support next generation satellite communication systems. The integrated space technologies are demonstrated by component or system level tests on the ground or in flight. Note: In FY 2004, Congress added \$1.2 million for Capacitively Coupled Interconnect, \$1.5 million for Magnetoresistive Random Access Memory (MRAM) Innovative Communications Materials, \$1.7 million for Integrated Spacecraft Engineering Tool, \$4.7 million for Radially Segmented Launch Vehicle Risk Reduction, \$2.1 million for AESIR Reusable Liquid Oxygen/Liquefied Natural Gas (LOX/LNG) Launch Vehicle Technology, \$3.5 million for Hardening Technologies for Spacecraft Protection (HTSP), \$4.7 million for Thin Amorphous Solar Arrays, \$2.8 million for Robust Aerospace Composite Materials/Structures, and \$3.5 million for Boron Energy Cell Development.

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing space system upgrades and/or new space system developments that have military utility and address warfighter needs.

R-1 Shopping List - Item No. 25-2 of 25-25

| Exhibit R-2, RDT&E Bu | udget Item Justification | DATE Februa | ary 2004 |
|--|--|----------------|----------------|
| DGET ACTIVITY Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603401F Advanced Spacecraft Tech | | • |
|) <u>B. Program Change Summary (\$ in Millions)</u> | | | |
| | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
|) Previous President's Budget | 54.884 | 72.114 | 60.282 |
|) Current PBR/President's Budget | 52.424 | 96.912 | 60.12 |
|) Total Adjustments | -2.460 | 24.798 | |
|) Congressional Program Reductions | | -0.072 | |
| Congressional Rescissions | | -0.830 | |
| Congressional Increases | -1.223 | 25.700 | |
| Reprogrammings SBIR/STTR Transfer | -1.225 -1.237 | | |
|) <u>Significant Program Changes:</u> | -1.237 | | |
| | | | |
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| | Ех | khibit R-2a, F | ₹DT&E Pro | ject Justif | ication | | | DA | TE February | 2004 |
|---|----------------------------|----------------|-----------|---|----------|----------|--|----------|----------------|-------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | | | 0 | PE NUMBER AND 0603401F Adv Fechnology | | | PROJECT NUMBER AND TITLE 2181 Spacecraft Payloads | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ In Winnons) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 2181 | Spacecraft Payloads | 14.633 | 22.477 | 18.013 | 18.326 | 19.780 | 36.219 | 36.2 | 23 Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | |
| | | T (16) (1 | | | | | | | | |

(U) <u>A. Mission Description and Budget Item Justification</u>

This project funds the development, demonstration, and evaluation of radiation-hardened space electronic hardware, satellite control hardware and software for advanced satellite surveillance operations, and development of advanced laser communications technologies to support next generation satellite communications systems. Improved space-qualifiable electronics and software for data and signal processing will be more interchangeable, interoperable, and standardized. In the near-term, this project's work concentrates on converting (i.e., radiation-hardening) commercial data and signal processor technologies for use in Air Force space systems. For mid-term applications, the Improved Space Computer Program will merge advanced, radiation-hardened space processor, memory, and interconnect technologies with commercially-derived, open system architectures to develop and demonstrate robust, on-board processing capabilities for 21st century Department of Defense satellites. In the long-term, this project area focuses on developing low-cost, easily modifiable software and hardware architectures for fully autonomous constellations of intelligent satellites capable of performing all mission related functions without operator intervention.

| (U) | B. Accomplishments/Planned Program (\$ in Millions) | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
|-----|---|----------------|----------------|----------------|
| (U) | MAJOR THRUST: Develop spacecraft microelectronic devices, including radiation-hardened data processors and | 8.117 | 8.373 | 8.554 |
| | ultra-high density strategically hardened memories, space-qualifiable, high density advanced packaging technology, | | | |
| | and micro-electro-mechanical systems (MEMS) components and applications. | | | |
| (U) | In FY 2003: Performed simulations and validated designs of a general purpose embedded processor at 500 million | | | |
| | instructions per second and digital signal processors at 1 billion operations per second. Fabricated and characterized | | | |
| | high density, low power chips comprised of innovative chalcogenide programmable memory elements. Integrated | | | |
| | chalcogenide into components such as field programmable logic and analog microelectronics. Developed macrocell | | | |
| | libraries for application specific integrated circuit technology for up to eight million gate devices. Developed and | | | |
| | demonstrated a micro-electro-mechanical based switch box multi-chip module and associated heuristics for | | | |
| | multi-switch box applications to smart-wiring manifolds. | | | |
| (U) | In FY 2004: Demonstrate functional elements for general-purpose processor at 500 million instructions per second | | | |
| | and digital signal processors at 1 billion operations per second. Develop architectures and design electronics circuits | | | |
| | in support of adaptable, self-repairing processors and memories. Demonstrate functional elements of | | | |
| | chalcogenide-based field programmable logic and analog microelectronics. Develop hardened-by-design primitive | | | |
| | cell libraries enabling the use of state-of-the-art commercial manufacturing plants for high performance, low-cost | | | |
| | electronics. Build MEMS and chalcogenide-based switches supporting multi-switch box applications to smart-wiring | | | |
| | manifolds. | | | |
| (U) | In FY 2005: Fabricate a general-purpose processor at 500 million instructions per second and digital signal | | | |
| Pro | pject 2181 R-1 Shopping List - Item No. 25-4 of 25-25 | | Exhibit R-2a | (PE 0603401F) |
| | 004 | | | |

| Exhibit R-2a, RDT&E Project J | ustification | DA | TE February | 2004 |
|---|---|-------|------------------------------------|--------------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology | | JMBER AND TITLE ecraft Payloads | ; |
| processors at one billion operations per second. Demonstrate electronics circuits self-repairing processors and memories enabling spacecraft capable of autonomou Build functional elements of chalcogenide-based field programmable logic and an hardened by design macrocell libraries enabling the use of state-of-the-art comme performance, low-cost electronics. Demonstrate elements for hieratical smart-win reconfiguring entire space asset subsystems. Implement the hardened-by-design for analog-to-digital converter demonstration; fabricate devices in the Silicon Gen (U) | alog microelectronics. Develop rcial manufacturing plants for high ing manifolds capable of nixed signal library and the design | | | |
| (U) MAJOR THRUST: Develop intelligent satellite system technologies for responsi satellite control, precision navigation, formation flying, and proximity operations constellations. | · · | 1.721 | 2.803 | 1.808 |
| (U) In FY 2003: Completed initial development of microsatellite cluster managemen control, and navigational capability for high fidelity spacecraft proximity operation and scheduling software for multiple satellites and the spacecraft and simulation of Developed initial guidance, navigation, and control algorithms for proximity oper Developed initial autonomous software technologies for responsive space system. | ns. Developed automated planning lata archiving and storage system. ations and large deployable systems. | | | |
| (U) In FY 2004: Expand the development of command, control, and navigational cap proximity operations with application to counterspace operations. Complete development of guidance, navigation, and control algorithms for proximi systems. Develop initial command and telemetry simulation for mission operation autonomous software technologies for responsive space systems. | ability for high fidelity spacecraft lopment of automated planning and archiving and storage system. y operations and large deployable | | | |
| (U) In FY 2005: Advance development of command, control, and navigational capab proximity operations with application to space capability protection. Complete da and control algorithms for proximity operations and large deployable systems. Fu simulation development for mission ops center testing. Integrate hardware-in-the into testbed, interface with spacecraft command and telemetry simulations, and be (U) | evelopment of guidance, navigation, arther command and telemetry -loop engineering development unit | | | |
| (U) MAJOR THRUST: Develop modeling, simulation, and analysis tools and data ex space-based surveillance systems, space capability protection technologies, acces experiments. | | 0.890 | 0.965 | 1.298 |
| (U) In FY 2003: Developed models for sparse, distributed aperture radio frequency (technology trades and systems engineering. Expanded models of sparse aperture systems analysis. Explored models of space-based surveillance systems for techn | RF distributed signal processing for | | | |
| Project 2181 R-1 Shopping Lis | t - Item No. 25-5 of 25-25 | | Exhibit R-2a (F | PE 0603401F) |

| | Exhibit R-2a, RDT&E Project Just | Exhibit R-2a, RDT&E Project Justification | | | | | |
|-----|--|--|-------|--|-----------|--|--|
| | GET ACTIVITY Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology | | T NUMBER AND TITLE pacecraft Payloads | | | |
| (U) | with emphasis on military utility analysis. In FY 2004: Refine models for sparse, distributed aperture radio frequency (RF) syst systems engineering. Further develop models of sparse aperture RF distributed signa models of space-based surveillance systems for military utility analysis. Develop init analysis tools for technical assessment of space capability protection and access/mobi physics-to-engineering-to-engagement level models for systems engineering, tech tra operations, and utility analysis applicable to potential flight experiments. | l processing. Refine simulation tial modeling, simulation, and ility technologies. Develop | | | | | |
| | In FY 2005: Complete development of models for sparse, distributed aperture RF system development of sparse aperture RF distributed signal processing models. Expand development of space-based surveillance systems for military utility analysis. Refine development of analysis tools for technical assessment of space capability protection and access/mobile develop physics-to-engineering-to-engagement level models for systems engineering and operations, and utility analysis applicable to potential flight experiments. | velopment of simulations of f modeling, simulation, and ility technologies. Continue to | | | | | |
| (U) | | | | | | | |
| (U) | MAJOR THRUST: Develop advanced space infrared technology and hardened focal acquisition, tracking, and discrimination of hot targets, as well as "cold body" targets midcourse warheads. In FY 2003: Demonstrated and characterized low temperature multi-color and low be plane arrays, and higher temperature arrays with improved radiation hardness. Fabric wavelength mercury cadmium telluride focal plane arrays, higher operating temperatur focal plane arrays, and focal plane arrays with optimal background-limited performant backgrounds. Transitioned multi-color quantum well photodetector designs and other technologies to large focal plane arrays. | such as decoys, satellites, and ackground detectors and focal cated and delivered longer ure mid-wavelength infrared nce for stressing space r promising infrared | 0.473 | 3.257 | 2.317 | | |
| | In FY 2004: Characterize higher operating temperature, mid-wave infrared focal plan fabrication and characterize higher operating temperature, mid-wave infrared FPAs. characterize first-ever dual band (mid-wave, long-wave) FPAs having an extended lo Investigate radiation hardened-by-design development for long wavelength infrared F surveillance applications. Explore detector interfacing concepts for larger-format, hig hyperspectral imaging systems. | Complete fabrication and ng-wave infrared response. FPAs for space-based passive gher capability space | | | | | |
| (U) | In FY 2005: Complete pathfinder, dual-band ("mid-wave, long-wave") FPA perform transition plans, and insert technology into a potential hyperspectral demonstration. Of performance of long wavelength infrared FPAs developed with "radiation hardened-be array and cryogenic detector multiplexer interfacing concepts that lead to improved, I hyperspectral imaging capabilities. Extend performance of dualband vapor phase group | Characterize and assess by-design." Investigate detector larger-format, space | | | | | |
| Pro | | tem No. 25-6 of 25-25 | | Exhibit R-2a (PE | 0603401F) | | |

| Exhibit R-2a, RDT&E Project Ju | Istification | | DATE February 20 | 04 |
|--|--|-------|---------------------|-----------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology | | NUMBER AND TITLE | |
| background levels to more stressing lower background levels endemic to space-ba | sed passive surveillance. | | | |
| (U) (U) MAJOR THRUST: Develop and demonstrate satellite antenna technologies that e integration, high-density interconnects/packaging and advanced phased array com lightweight space antennas. | - | 2.271 | 1.430 | 1.903 |
| (U) In FY 2003: Tested and integrated selected embedded-structural transmit-receive future multi-microsatellite constellation space flight experiment. Tested, integrate wide-bandwidth transmit-receive electronics antenna modules with payloads for p experiment. Fabricated and tested antenna modules that address requirements for embedding lightweight electronics in the structure. | d, and evaluated multi-beam, ossible airborne, multi-mode flight | | | |
| (U) In FY 2004: Deliver flight-ready multi-beam, wide-bandwidth antenna modules f experiment. Redesign baseline antenna module tiles using advanced substrate ma weight by 25%. Develop and demonstrate ten milliwatt advanced low power, octa amplifier. Apply Application Specific Integrated Circuit technology to achieve a transmit-receive cells, reducing discrete components by 25%. Redesign antenna t generation miniaturized phased array components to support eight simultaneous b multi-decade-bandwidth antenna architecture. | terial to reduce antenna module ave-wide bandwidth, low noise higher level of integration for the le architecture to incorporate next eams. Design | | | |
| (U) In FY 2005: Achieve an additional 25% reduction in discrete component requirer developing wide-bandwidth radio frequency manifold techniques for implementat architecture. Complete redesign of tile architecture to incorporate new miniaturize support eight simultaneous beams. Demonstration of multi-decade-bandwidth ant design and development of sparse membrane array architectures for next generation antenna that extends the transmit/receive technology to autonomous beam control. | ion in baseline antenna module tiles ed phased array components to enna architecture. Investigate on agile beam control and smart | | | |
| | | 0.000 | 0.000 | 1.046 |
| (U) MAJOR THRUST: Develop technologies for multi-access laser communications weight, power, and cost for transformational communications. | space terminals with reduced | 0.000 | 0.990 | 1.946 |
| (U) In FY 2003: Not Applicable. | | | | |
| (U) In FY 2004: Investigate component integration issues and identify technical chall experiments of multi-access laser communications systems. Develop initial groun space-based laser communications architecture studies. | d breadboard testbed. Complete | | | |
| (U) In FY 2005: Explore component integration issues of multi-access laser communi- breadboard testbed. Test breadboard terminal designs in approved compatibility to laser communications terminal brassboard development. | | | | |
| (U) | | | | 00004045 |
| Project 2181 R-1 Shopping Lis | t - Item No. 25-7 of 25-25 384 | | Exhibit R-2a (PE | 0603401F) |

| Exhibit R-2a, RDT&E Proje | DA | DATE February 2004 | | | |
|--|---|--|-----------------|--------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology | PROJECT NUMBER AND TITLE 2181 Spacecraft Payloads | | | |
| (U) MAJOR THRUST: Develop satellite payload subsystem technologies to exoperability, responsiveness, and cost-effectiveness. (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop enabling responsive spacecraft technologies, which in configurable, logic, and modular, reusable, self-initiating software, as well and interpreting and height artellity abaded. | nclude on-the-fly programmable, | 0.000 | 1.982 | 0.000 | |
| integration and minimum time on-orbit satellite checkout.(U) In FY 2005: Not Applicable.(U) | | | | | |
| (U) MAJOR THRUST: Develop spectral sensing and data exploitation capabili sensing applications. Note: Reflects increased emphasis on spectral sensing (U) In FY 2003: Not Applicable. (U) In FY 2004: Not Applicable. (U) In FY 2005: Demonstrate spectral sensing and data exploitation capabilities | g technology. | 0.000 | 0.000 | 0.187 | |
| applications. Analyze technology and modeling results to advance the unde polarimetric phenomology and initiate investigations into new instrumentati polarimetric signature modeling capability to assess space-based surveillance | rstanding of electro-optical/infrared on for space applications. Apply | | | | |
| (U) (U) CONGRESSIONAL ADD: Capacitively Coupled Interconnect. (U) In FY 2003: Developed integrated circuit interconnection technology based provides denser, more powerful computation capabilities, increased bandwide systems, and improved flexibility and increased reliability. Investigated the interconnects and assessed their performance against traditional approaches. proof of principle based on findings. | dth within and between electronic oretical basis of capacitively coupled | 1.161 | 1.190 | 0.000 | |
| (U) In FY 2004: Using previously established and proven principles, provide a non-conductive interconnection technology, in a form suitable for transfer to demonstrates all the advantages of non-conductive interconnection technolo of packaging. (U) In FY 2005: Not Applicable. | o industry. Build an electronic system that | | | | |
| (U) IN FY 2003: Not Applicable. (U) CONGRESSIONAL ADD: Magnetoresistive Random Access Memory (MI Materials. (U) In FY 2003: Not Applicable. | RAM) Innovative Communications | 0.000 | 1.487 | 0.000 | |
| (U) In FY 2004: Develop and characterize a magnetic tunneling junction magne- size, along with supporting circuitry and architecture models, leading to dist | | | Exhibit R-2a (F | PE 0603401F) | |

| | | Exhibit R- | 2a, RDT&E | Project Ju | stification | | | DATE | Fobruary | 2004 | | |
|-----|---------------------------------------|--------------------------|-----------------|------------------|--------------------|-----------------|-----------------|-----------------|---|-------------------|--|--|
| | | | | | | | | | February 2004 OJECT NUMBER AND TITLE 81 Spacecraft Payloads | | | |
| | memory for embedded and reconfig | gurable spacecraf | t computing sys | tems. | | | | | | | | |
| | In FY 2005: Not Applicable. | | | | | | | | | | | |
| (U) | Total Cost | | | | | | | 14.633 | 22.477 | 18.013 | | |
| (U) | C. Other Program Funding Sum | <u>mary (\$ in Milli</u> | <u>ons)</u> | | | | | | | | | |
| | | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | FY 2006 | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> | Cost to | Total Cost | | |
| | | <u>Actual</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Complete</u> | <u>Total Cost</u> | | |
| (U) | Related Activities: | | | | | | | | | | | |
| | PE 0303601F, MILSTAR | | | | | | | | | | | |
| (U) | Satellite Communications | | | | | | | | | | | |
| | System. | | | | | | | | | | | |
| | PE 0305160F, Defense | | | | | | | | | | | |
| (U) | Meteorological Satellite | | | | | | | | | | | |
| | Program (DMSP). | | | | | | | | | | | |
| (U) | PE 0602601F, Spacecraft | | | | | | | | | | | |
| . , | Technology. | | | | | | | | | | | |
| (U) | PE 0603311F, Ballistic Missile | | | | | | | | | | | |
| | Technology. | | | | | | | | | | | |
| (U) | PE 0603215C, Limited Defense | | | | | | | | | | | |
| | System. | | | | | | | | | | | |
| (U) | PE 0603218C, Research and | | | | | | | | | | | |
| | Support. PE 0603226E, Experimental | | | | | | | | | | | |
| an | Evaluation of Major Innovative | | | | | | | | | | | |
| (0) | Technologies. | | | | | | | | | | | |
| | PE 0604609F, Reliability and | | | | | | | | | | | |
| ЛD | Maintainability Technology | | | | | | | | | | | |
| (0) | Insertion Program (RAMTIP). | | | | | | | | | | | |
| | This project has been | | | | | | | | | | | |
| | coordinated through the | | | | | | | | | | | |
| (U) | Reliance process to harmonize | | | | | | | | | | | |
| | efforts and eliminate | | | | | | | | | | | |
| | duplication. | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Pro | oject 2181 | | R | -1 Shopping List | Item No. 25-9 of 2 | 5-25 | | | Exhibit R-2a (| PE 0603401F) | | |

| Exhibit R-2a, RDT& | DATE February 2004 | | | |
|--|---|------------------------|--|--|
| DGET ACTIVITY Advanced Technology Development (ATD) | | | | |
|) D. Acquisition Strategy Not Applicable. | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| oject 2181 | R-1 Shopping List - Item No. 25-10 of 25-25 | Exhibit R-2a (PE 06034 | | |

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|----------------------------|---|--|---|--|--|---|------------------|--|-----------------|--------------|
| | ET ACTIVITY dvanced Technology Development (| ATD) | | 0 | 0603401F Advanced Spacecraft 3 | | | PROJECT NUMBER AND TITLE 3834 Integrated Space Technology Demonstrations | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 3834 | Demonstrations | 13.243 | 28.693 | 18.584 | 25.057 | 27.460 | 26.531 | 26.716 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) (U)] | A. Mission Description and Budget Item This project is a series of advanced techno Laboratory, other Government laboratorie the technologies in an relevant environme B. Accomplishments/Planned Program (| blogy demonstra es, and industry. ent. | - | | • | | strations that a | | | |
| (U)] | MAJOR THRUST: Develop autonomous modular microsatellite technology concept. | microsatellite (1 | 10-100kg) tech | nologies for an | integrated, rob | ust, flexible, | 1 | 0.342 | 20.265 | 18.584 |
| 1 8]] 1 | In FY 2003: Performed mission operations mission planning tools for non-cooperative system level integration, functional, and en Performed final launch vehicle safety analy hardware-in-the-loop and software simulation microsatellite around a non-cooperative res | proximity oper wironmental test ysis and ground ions to perform sident space obj | ations. Compl t activities in p test and evalua comprehensive ect. | eted componen preparation for ation. Used mi e ground testin | nt development launch and oper crosatellite g of the autonor | and began rations. mous | | | | |
| 1 3 3 2 2 2 | In FY 2004: Develop and test a laser range real-time planning and flight operations of against simulated faults and anomalies. Co and environmental tests. Integrate microsa Begin integration with launch vehicle. Inte simulated proximity operations missions for spacecraft performance and interaction with In FY 2005: Complete development of aut | proximity opera omplete system itellite with laun egrate ground co or mission opera h ground contro | ations microsat level integration ich system and ontrol system a utions training a ollers. | ellite. Test aut on of microsate perform functi nd satellite sof and for determi | tonomous opera ilite and completional and enviro tware simulatio ination of the sin | tions software ete functional onmental tests. ns. Perform mulated | | | | |
| | system. Perform real time simulated mission vehicle integration and launch. Perform m objects. Evaluate options for potential follo operational concept trades. Perform prelim best payload option. Initiate satellite bus d | on experiments ission operation ow-on space sit ninary design co | beyond spaced as around one of uational aware oncept trades an | raft envelop. (or more non-co- ness technolog nd initial satelli | Complete satelli operative reside y demonstration ite design(s.) D | ite/launch ent space n, using | | | | |
| (U) | | | | | | | | | | |
| Proje | ect 3834 | | R-1 Sho | opping List - Item | No. 25-11 of 25-2 | 25 | | | Exhibit R-2a (F | PE 0603401F) |

| Exhibit R-2a RDT8 | E Project Justification | | DATE | | |
|--|--|---------|--|--------------|--|
| | · · · · · · · · · · · · · · · · · · · | | February | 2004 | |
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology | 3834 In | ECT NUMBER AND TITLE Integrated Space Technology onstrations | | |
| (U) CONGRESSIONAL ADD: Next Generation Hybrid Orbital Ma (U) In FY 2003: Explored technologies for a small, hybrid propulsion Shuttle payloads to higher operational orbits after deployment. I Test information was used to assess whether the hybrid technology Shuttle safety requirements. (U) In FY 2004: Not Applicable. | on module capable of transferring selected Space ntegrated and ground test fired a propulsion module. | 0.967 | 0.000 | 0.000 | |
| (U) In FY 2005: Not Applicable. | | | | | |
| (U) (U) CONCRESSIONAL ADD: Starsher Small Laurah Vahiala | | 0.967 | 0.000 | 0.000 | |
| (U) CONGRESSIONAL ADD: Streaker Small Launch Vehicle. (U) In FY 2003: Developed technologies for small launch vehicles f and Common Aero Vehicle payloads. Conducted trade studies to launch vehicle. Defined preliminary system design requirements and mission and life cycle cost estimates for a small launch vehicle. Low Earth Orbit. | b define a responsive, simple, cost-effective small s and developed a mission model, a system concept, | 0.907 | 0.000 | 0.000 | |
| (U) In FY 2004: Not Applicable. | | | | | |
| (U) In FY 2005: Not Applicable. | | | | | |
| (U) | | | | | |
| (U) CONGRESSIONAL ADD: Integrated Spacecraft Engineering T (U) In FY 2003: Developed an integrated engineering, modeling, sir and collaborative Research, Development, Test, and Evaluation of enables quick turnaround, advanced space mission analyses that determine the impact on system performance and capabilities. In analysis, and optimization software into a combined systems ana to predict performance benefits and impacts for new technologie | nulation, and design tool to support rapid modeling of advanced spacecraft and launch vehicles. This tool incorporate future military space requirements to ntegrated government and commercial design, lysis and design tool set that advances the capability | 0.967 | 1.686 | 0.000 | |
| (U) In FY 2004: Expand the capabilities of an existing integrated en supports rapid modeling and collaborative Research, Developme launch vehicles. Enhanced capabilities include modeling of mor atmospheric reentry performance for studies of future tactical con- | nt, Test, and Evaluation of advanced spacecraft and e complex launch vehicle concepts, and vehicle | | | | |
| (U) In FY 2005: Not Applicable. | | | | | |
| (U)(U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle | e (RSLV) Rick Reduction | 0.000 | 4.660 | 0.000 | |
| (U) In FY 2003: Not Applicable. | | 0.000 | т.000 | 0.000 | |
| (U) In FY 2003: Not Applicable.(U) In FY 2004: Validate the cost and performance of a rocket engin Validate cost, mass properties, and structural performance of the | | | | | |
| Project 3834 | R-1 Shopping List - Item No. 25-12 of 25-25 | | Exhibit R-2a (I | PE 0603401F) | |
| | 389 | | | / | |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | | DATE Februar | y 2004 |
|--|--|---|--|---|-----------------------------------|-----------------------------------|---|-----------------|-------------|
| BUDGET ACTIVITY 03 Advanced Technology Developr | ment (ATD) | | | PE NUMBER A 0603401F A Technology | dvanced Spa | cecraft | PROJECT NUMBER AND TITLE 3834 Integrated Space Technolog Demonstrations | | |
| fabrication and destructive testing. (U) In FY 2005: Not Applicable. (U) (U) CONGRESSIONAL ADD: AESIR | | | | | | | 0.000 | 2.082 | 0.000 |
| Technology. U) In FY 2003: Not Applicable. U) In FY 2004: Fabricate and test 30,0 propulsion concepts. This effort coucooled chamber propulsion system a reusable, configurable-plume propulsimple pressure-fed design to support U) In FY 2005: Not Applicable. U) Total Cost | ald lead to a rela and a two-stage- lsion system and | tively high perfo to-orbit vehicle l target vehicle d | ormance, reusab system concept; lesign. The targ | le 30K, pump-fe effort could also et vehicle will b | d, regenerativel | у | 13.243 | 28.693 | 18.584 |
| U) <u>C. Other Program Funding Sumn</u> | nour (¢ in Milli | (ang) | | | | | 15.245 | 28.095 | 18.384 |
| (U) Related Activities: PE 0602601F, Spacecraft Technology. (U) PE 0603605F, Advanced Weapons Technology. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. | FY 2003 Actual | FY 2004 Estimate | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | FY 2 Estin | | I ofal Cost |
| Project 3834 | | R- | | ltem No. 25-13 of 3 390 | 25-25 | | | Exhibit R-2a | (PE 0603401 |

| | Quantity of RDTRE Articles 0 </th <th>2004</th> | 2004 | | | | | | | | |
|---|---|---|---|---|--|--|----------------|---------------------------------|----------------------|-----------------------|
| | | (ATD) | | 0 | 603401F Adv | | ecraft | | | ection |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ in Winnons) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | e Complete | |
| 4400 | | 2.688 | 9.432 | 3.473 | 3.505 | 3.570 | 3.630 | 3.6 | 688 Continuing | TBD |
| | | - | ~ | ţ. | ţ. | ů | ÷ | | ÷ | |
| | A. Mission Description and Budget Ite This project develops and demonstrates environments. The project performs ass This project also develops technologies | em Justification tools, instrument essments of criti- that mitigate iden | s, and mitigation cal components ntified vulnerab | on techniques res and subsystem bilities. Techno | equired to assu ns, and evaluate | re operation of es susceptibility | U.S. space ass | ets in potent ility to radio | ially hostile warfig | ghting er threats. |
| (U) I | B. Accomplishments/Planned Program MAJOR THRUST: Use multi-threat asse | (\$ in Millions) essment tools to a | assess space-ba | sed electro-opt | | | <u>F</u> } | | | |
| (U) 1 1 5 (U) 1 5 5 1 | In FY 2003: Verified and accredited initial users, and developed additional tools for a satellite buses. In FY 2004: Use existing satellite subsyst weapons effects for processor assemblies satellite constellation analysis tool. Assemblaser susceptibility and potential mitigation | al weapons effect satellite subsyste stem response dat , optical trains, a ss electro-optical on techniques. A | ts satellite asse ms, such as pro ta to continue v nd satellite bus designs of pla ssess directed of | essment tools, c occessor assemb verification of s es. Integrate si nned space syst energy threat su | completed docu lies, optical trai ingle satellite n ingle satellite m tems for radio f | mentation for ins, and nodels of nodels into irequency and | | | | |
| (U) l i | In FY 2005: Investigate models for radio integration into single satellite communic | frequency and lations and power | aser response in r subsystem mo | n communication odels into satell | | | I | | | |
| (U) l | | ellite countermea | sures and mitig | gation technique | es for current a | nd future | | 1.524 | 2.732 | 2.022 |
| (U) 1 2 0 | In FY 2003: Designed plasma shield to s antennas; prepared for conceptual space of determine the impact of satellite self-prot | lemonstration. C | Conducted designments | gn and trade stu s technologies (| idies and analys | ses to ns operations. | | | | |
| Proje | ect 4400 | | R-1 Sho | opping List - Item | No. 25-14 of 25- | 25 | | | Exhibit R-2a (| PE 0603401F) |
| | | | | 391 | | | | | | |

| Exhibit R-2a, RDT&E Pro | ject Justification | DA | | 2004 |
|--|--|---|---|---|
| | PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology | | IMBER AND TITLE | |
| | ns. Explored electronic protection techniques | | | |
| In FY 2004: Complete plasma shield design and define potential system studies and analyses to determine the impact of satellite self-protection ar space systems operations. Investigate mitigation technologies such as dep | nd situational awareness technologies on | | | |
| In FY 2005: Investigate and identify candidate threat mitigation technolo as shielding and terminal protection techniques for multi-chip modules, re | | | | |
| and juin moderns for uprink subsystems. | | | | |
| In FY 2003: Completed initial evaluations and ground-based demonstration | 5 | 0.749 | 1.369 | 0.441 |
| In FY 2004: Develop adaptive signal processing techniques to mitigate la electronics and focal plane array sensor subsystem components. Design a incorporating adaptive signal processing techniques. Develop optical sen | and fabricate an optical sensor subsystem usor subsystem threat mitigation techniques | | | |
| sensor subsystem incorporating selective mitigation approaches. Develop | p selected protection techniques and evaluate | | | |
| | | 0.000 | 2.470 | 0.000 |
| | tion (HISP). | 0.000 | 3.470 | 0.000 |
| In FY 2004: Examine, evaluate, and summarize potential protection tech designers, with a goal of minimal impacts of additional weight and power Establish relationships with commercial system designers to explore acce commercial systems. Develop and test prospective protection techniques for enhanced survivability. Expand ability to accurately predict the nucle Altitude Nuclear Event, enhancing the ability of designers to accurately d Complete Version 1 of the Satellite Survivability Module code to include laser effects within the Satellite Toolkit framework. | r, integration issues, and performance loss. eptable approaches for applications to , filters, rugates, and/or limiters applicable ear environment associated with a High letermine their system vulnerability. | | | |
| ** | | | | |
| Total Cost | | 2.688 | 9.432 | 3.473 |
| ect 4400 R-1 Sho | | | Exhibit R-2a (F | |
| | GET ACTIVITY Advanced Technology Development (ATD) peacetime mission would be compromised by on-board protection system for optical sensors and systems. In FY 2004: Complete plasma shield design and define potential system studies and analyses to determine the impact of satellite self-protection an space systems operations. Investigate mitigation technologies such as de- control for radio frequency threats. In FY 2005: Investigate and identify candidate threat mitigation technolo as shielding and terminal protection techniques for multi-chip modules, re anti-jam modems for uplink subsystems. MAJOR THRUST: Develop visible and near-infrared laser protection te In FY 2003: Completed initial evaluations and ground-based demonstrat protection techniques in preparation for space demonstrations. In FY 2004: Develop adaptive signal processing techniques to mitigate 1 electronics and focal plane array sensor subsystem components. Design a incorporating adaptive signal processing techniques. Develop optical ser using solutions such as acousto-optical switches to deflect incoming laser In FY 2005: Demonstrate visible and near-infrared laser protection techr sensor subsystem incorporating selective mitigation approaches. Develop effectiveness as a laser mitigation technique of optical sensor subsystems CONGRESSIONAL ADD: Hardening Technologies for Satellite Protect In FY 2004: Examine, evaluate, and summarize potential protection techn designers, with a goal of minimal impacts of additional weight and power Establish relationships with commercial system designers to explore acce commercial systems. Develop and test prospective protection techniques for enhanced survivability. Expand ability to accurately predict the nucle Altitude Nuclear Event, enhancing the ability of designers to accurately of | Advanced Technology Development (ATD) D663401F Advanced Spacecraft Technology peacetime mission would be compromised by on-board protection systems. Explored electronic protection techniques for optical sensors and systems. In FY 2004: Complete plasma shield design and define potential system applications. Refine selected design trade studies and analyses to determine the impact of satellite self-protection and situational awareness technologies on space systems operations. Investigate mitigation technologies such as deployable shields and triggered automatic gain control for radio frequency threats. In FY 2005: Investigate and identify candidate threat mitigation technologies for principle satellite subsystems, such as shielding and terminal protection techniques for multi-chip modules, reconfigurable processors/architectures, and anti-jam modems for uplink subsystems. MAJOR THRUST: Develop visible and near-infrared laser protection technologies. In FY 2003: Completed initial evaluations and ground-based demonstrations of visible and near-infrared laser protection techniques in preparation for space demonstrations. In FY 2004: Develop adaptive signal processing techniques. In FY 2005: Demonstrate visible and near-infrared laser protection technologies. In FY 2004: Develop adaptive signal processing techniques. In FY 2005: Demonstrate visible and near-infrared laser protection technologies. In FY 2005: Demonstrate visible and near-infrared laser protection techniques and evaluate effectiveness as a laser mitigation technologies for Satellite Protection (HTSP). In FY 2003: Not Applicable. | EXhibit R-23, RD1&E Project Justification GeT ACTIVITY dvanced Technology Development (ATD) PE NUMBER AND TITLE (603401F Advanced Spacecraft Technology PROJECT NU 4400 Space geneetime mission would be compromised by on-board protection systems. Explored electronic protection techniques for optical sensors and systems. PROJECT NU 4400 Space In FY 2004: Complete plasma shield design and define potential system applications. Refine selected design trade studies and analyses to determine the impact of satellite self-protection and situational awareness technologies on space systems operations. Investigate mitigation technologies such as deployable shields and triggered automatic gain control for radio frequency threats. 0.749 In FY 2003: Investigate and identify candidate threat mitigation technologies. 0.749 In FY 2004: Completed initial evaluations and ground-based demonstrations of visible and near-infrared laser protection techniques in preparation for space demonstrations. 0.749 In FY 2005: Develop adaptive signal processing techniques. Develop optical sensor subsystem fire an optical sensor subsystem incorporating adaptive signal processing techniques. Develop optical sensor subsystem fire an optical lens array. In FY 2005: Demonstrate visible and near-infrared laser protection technologies. Conduct ground test of optical sensor subsystem incorporating selective mitigation approaches. Develop selected protection techniques using solutions such as a cousto-optical switches to deflect incoming laser energy from the focal plane array. In FY 2005: Demonstrate visible and near-infrared lasers or toxolyte accountely busible and near-infrared laser protection techniques and evaluat | GET ACTIVITY PENUMBER AND TITLE PENUMBER AND TITLE PROJECT NUMBER AND TITLE dvanced Technology Development (ATD) PENUMBER AND TITLE PROJECT NUMBERAND TITLE 4400 Space Systems Prot generating in the strength of the str |

| | UNCLASSIFIED | DATE |
|---|---|---|
| Exhibit R-2a, RDT&E P | Project Justification | February 2004 |
| BUDGET ACTIVITY 3 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology | T NUMBER AND TITLE pace Systems Protection |
| J) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | |
| U) <u>D. Acquisition Strategy</u> Not Applicable. | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Project 4400 R-1 | Shopping List - Item No. 25-16 of 25-25 393 | Exhibit R-2a (PE 06034 |

| | ExI | nibit R-2a, I | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|-----|---|--|---|---|---|---|---------------|--|-----------------|----------------|
| | GET ACTIVITY Advanced Technology Development (| ATD) | | 0 | PE NUMBER AND 1603401F Adv Fechnology | | ecraft | PROJECT NUMBER AND TITLE 5021 Space Systems Survivab | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 502 | | 3.878 | 4.136 | 4.775 | 4.854 | 4.982 | 5.066 | 5.147 | Continuing | TBD |
| | Quantity of RDT&E Articles e: In FY 2003, selected efforts from Project | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) | A. Mission Description and Budget Iter This project develops and demonstrates te must continue operation despite natural sp including electrical charge buildup and el | echnologies to in pace hazards. It | develops and d | lemonstrates co | ost-effective sol | utions to mitiga | ate hazardous | | | |
| (U) | B. Accomplishments/Planned Program (| (\$ in Millions) | | | | | FY | <u>2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| (U) | MAJOR THRUST: Develop sensors to sp operation of satellite, communication, navi and operation of instrumentation to provide forecasting. In FY 2003: Launched, completed initial of forecasting algorithms using space-based a electron and proton detector and demonstra quantify hazards to space systems. Develo operational space weather forecasting syste | gation, and sur- e improved space on-orbit checkor Ill-sky camera. ated ability to poped initial conce em. | veillance syster ce radiation and ut, and commen Performed joir erform on-orbit eptual design o | ns. Support in d ionospheric h nced validation agency collat t mapping of th of advanced all- | tegration, launc hazard specificat n of solar disturt boration to fly r he dynamic radi -sky, white ligh | h, validation, tion and pances elativistic ation belts to t camera for | | 0.948 | 1.034 | 1.432 |
| | In FY 2004: Validate solar disturbance for instrument and data plan for joint-agency r choices for spacecraft orbits. Expand space situ plasma and magnetic field sensors in a nano-technology based concepts to miniatu needed to characterize space weather hazar In FY 2005: Complete all-sky image based operational forecasters. Integrate relativist Investigate development of miniaturized pl interplanetary microsatellites. Determine of highest capability energetic particle, neutra characterization. | nission to map to e weather forec ddition to minia urize energetic p rds. d solar disturbatic ic particle sense lasma, magnetic optimal micro- a | the high-intensi asting system c aturized white- particle, neutral nce forecast algor or onto joint-ag field, and all-s and nano-techn | ity region of th conceptual desi light camera. I density, and lo gorithms and tra- gency radiation sky white light ology path to a | e radiation belt gn to include in Develop initial n ow energy plass ansition to milit belt mapping si cameras for inc achieve maximu | that limits aterplanetary in micro- and na sensors tary/civilian atellite. clusion on | | | | |
| | 1 - 1 - 2 - 2 - 1 | | | | | 05 | | | | |
| Pro | bject 5021 | | R-1 Sho | opping List - Item | No. 25-17 of 25-2 | 25 | | | Exhibit R-2a (F | - 2E 0603401F) |

| Exhibit R-2a, RDT&E | Project Justification | DA | February | 2004 |
|--|--|-------|-----------------------------------|--------------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology | | IMBER AND TITLE e Systems Surv | rivability |
| (U) MAJOR THRUST: Conduct collaborative space and laboratory expections to improve the survivability of spacecraft power, communication (U) In FY 2003: Completed design and began fabrication of second-generation of the conceptual design of an experiment to quantify the effects systems and determined feasibility of a space flight test to demonstrate Completed interface between dynamic space plasma and meteor models. | ons, navigation, and surveillance systems. eration miniaturized charge control system. s of space plasma on tethered power generation ate on-orbit electrical power generation. | 0.966 | 1.449 | 1.911 |
| (U) In FY 2004: Complete model testing of miniaturized charge control experiment for the hazardous geosynchronous environment. Develop electrical power generation and particle scattering capabilities of space spacecraft environment effect tools for operational use by integrating forecast models with spacecraft hazard, trans-ionospheric link degrad Investigate design of active antenna and passive detection hardware for lowering radiation belt intensities to protect satellites. | system and begin construction of space p a space experiment to validate on-orbit ce tether. Develop initial suite of comprehensive g full range of environment specification and dation, and satellite drag specification tools. | | | |
| (U) In FY 2005: Integrate geosynchronous charge control system onto sphazard mitigation. Refine space tether experiment hardware and fina ionospheric and satellite drag effects into spacecraft environment effect and begin fabrication of payload for space experiment to actively expradiation belt remediation technologies. | alize space test plan. Complete integration of ect tool suite. Complete hardware suite selection | | | |
| (U) | | 1.064 | 1 (52) | 1 420 |
| (U) MAJOR THRUST: Develop technology to warn of spacecraft radiat provide space environment situational awareness and anomaly resolu- systems. | | 1.964 | 1.653 | 1.432 |
| (U) In FY 2003: Developed data assimilation techniques to produce imp from multiple compact environment anomaly sensors. Fabricated ini environment distributed anomaly resolution sensor for on-orbit detec hazards. Developed detailed design of active wave and electron bear of satellite protection technologies. | itial components of miniaturized space tion of space particle, chemical, and impact | | | |
| (U) In FY 2004: Complete development of first-generation data assimila based on single compact environment anomaly sensor inputs. Comp comprising distributed anomaly resolution sensors and begin hardwa wave and electron beam space experiment to demonstrate the feasibility. | lete concept design for space hazard detectors re development. Refine detailed design of active | | | |
| (U) In FY 2005: Advance global radiation hazard situational awareness is sensor inputs to improve accuracy and timeliness. Fabricate flight re hazard sensors needed for space situational awareness. Complete des | ady engineering model of distributed space | | | |
| | 1 Shopping List - Item No. 25-18 of 25-25 | | Exhibit R-2a (F | PE 0603401F) |

| | | | | | ASSIFIED | | | | | |
|-----|---|---------------------------------|-----------------------------------|-----------------------------------|---|-----------------------------------|-----------------------------------|-----------------------------------|---------------------|-------------------|
| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
| | GET ACTIVITY Advanced Technology Develop | oment (ATD) | | | PE NUMBER A 0603401F A Technology | dvanced Space | cecraft | PROJECT NUMB 5021 Space S | | vivability |
| (U) | severe radiation environments. Pla Total Cost | an for space test fl | ight of active w | ave and distribu | ted sensor techno | ologies. | | 3.878 | 4.136 | 4.775 |
| (U) | C. Other Program Funding Sun | <u>nmary (\$ in Milli</u> | <u>ons)</u> | | | | | | | |
| (U) | PE 0602601F, Spacecraft | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | Cost to Complete | <u>Total Cost</u> |
| (U) | Technology. This project has been coordinated through the Reliance process to harmonize efforts and eliminate | | | | | | | | | |
| (U) | duplication. D. Acquisition Strategy Not Applicable. | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Pro | bject 5021 | | R· | | Item No. 25-19 of 2 | 25-25 | | | Exhibit R-2a (| PE 0603401F) |

| | Exhibit R-2a, RDT&E Project Justification February 2004 | | | | | | | | | |
|---|--|---|--|--|--|--|-----------------|------------------------|----------------------------------|-------------------------|
| | GET ACTIVITY dvanced Technology Development | (ATD) | | Q | PE NUMBER AND 1603401F Adv Technology | | ecraft | | IBER AND TITLE ic Missiles Te | chnology |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | × , , | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 5083 Ballistic Missiles Technology 0.000 6.802 6.859 5.815 4.069 4.137 4.204 Cont | | | | | | | | | | TBD |
| | Quantity of RDT&E Articles This is a new project, but not a new start | 0 | 0 | 0 | 0 | 0 | 0 | , | | |
| | A. Mission Description and Budget Iter This project develops, integrates, and der developing robust, low maintenance inert | ry organization. m Justification nonstrates advar tial navigation ir | nced technolog | ies for sustainn | nent and moder | nization of stra | tegic ballistic | missiles. The | project focuses of | on |
| (U) (U) (U) (U) | instrumentation for next generation missi B. Accomplishments/Planned Program MAJOR THRUST: Develop, integrate, an vehicle designs and other technologies tha technology concepts to support future space In FY 2003: Not Applicable. In FY 2004: Evaluate the most promising and accelerometer systems into a breadboar instrument system that approaches or excer In FY 2005: Downselect to the most advar ballistic missiles. Evaluate the designs an | (\$ in Millions) ad demonstrate a t sustain current ce force applicat navigation instr ard demonstration eds ballistic mis nced navigation | strategic missi ion and strateg umentation tec on of a reduced ssile mission go al instrumentat | ile systems. Pr cic systems. chnologies and size and reduc oals. tion designs for | ovide critical m integrate the ad ed power navig | issile vanced gyro ation ation of | <u>F</u> Y | <u>7 2003</u> 0.000 | <u>FY 2004</u> 3.887 | <u>FY 2005</u> 3.920 |
| | Demonstrate and validate improved navig | | | | - | Bouist | | | | |
| | MAJOR THRUST: Develop, integrate, ar to provide robust, flexible, lower cost solu technological base for future systems. | | - | | - | - | | 0.000 | 2.915 | 2.939 |
| (U) | In FY 2003: Not Applicable. In FY 2004: Integrate advanced thermal m selective targeting. Demonstrate lower-co validate improved properties for future vel range safety devices can withstand loads g | ost, robust leadin hicle designs. D | g edge, and co emonstrate that | ntrol surface m at robust onboa | aterials in a tes rd navigation in | t flight to | | | | |
| (U) | In FY 2005: Evaluate advanced thermal n controllability and selective targeting. Eva | naterials integra | ted with long-g | glide vehicles to | o provide greate | | | | | |
| | ect 5083 | | | | No. 25-20 of 25-2 | | | | Exhibit R-2a (I | PE 0603401F) |
| | | | | 397 | | | | | | , |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | D | February | 2004 |
|--|---|---|-------------------|---|----------------|----------|---------------------------|---------------------------|---------------------|
| BUDGET ACTIVITY 03 Advanced Technology Develo | pment (ATD) | | | PE NUMBER A 0603401F A Technology | dvanced Space | cecraft | | UMBER AND TITLE | |
| Materials and initiate down select designs. Use results of laboratory safety devices to withstand loads (U) (U) Total Cost (U) C. Other Program Funding Surface (U) PE 0601102F, Defense Research Sciences. (U) PE 0602601F, Space (U) Technology. (U) PE 0603601F, Conventional Weapons Technology. (U) PE 0603851F, Intercontinental Ballistic Missile-Dem/Val. (U) PE 0605860F, Rocket System Launch Program-Space. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate | ion to candidates p testing to improve greater than 100G mmary (\$ in Milli <u>FY 2003</u> <u>Actual</u> | e the capability of in all axes in flig | of onboard navig | Technology robust advanced gation instrumen | future vehicle | Estimate | 0.000 FY 200 Estima | 6.802 <u>9 Cost to</u> | 6.859 Total Cost |
| duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | | | | | | |
| Project 5083 | | R- | 1 Shopping List - | Item No. 25-21 of 2 | 25-25 | | | Exhibit R-2a | (PE 0603401F) |

| | ExI | hibit R-2a, F | RDT&E Pro | ject Justifi | ication | | | | DATE | February | 2004 |
|------------|---|---|--------------------------------------|-------------------------------------|--|----------------------------------|---------------------------------|------------------------|---|-------------------------|-------------------------|
| | GET ACTIVITY dvanced Technology Development (| (ATD) | | 0 | E NUMBER AND 603401F Adv echnology | | ecraft | | OJECT NUMBER AND TITLE 2J Spacecraft Vehicles | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2 | | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estir | | Complete | |
| 682J | | 17.982 | 25.372 0 | 8.420 0 | 8.335 0 | 12.224 | 12.665 | | 14.969 0 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | |
| (U) | A. Mission Description and Budget Iter This project develops and demonstrates or including cryogenic cooling technologies focuses on lightweight nickel hydrogen ar project's power distribution efforts focus | ompact, low-cos . Power generat nd sodium sulfu | tion activities f r spacecraft ba | ocus on lightwo tteries and flyw | eight, low-cost, wheel energy sto | low-volume, a orage systems f | nd survivable or extended (f | solar cel | ll arrays n year) s | . Energy storag | ge work |
| (U) | B. Accomplishments/Planned Program (MAJOR THRUST: Develop and evaluate multi-junction solar cells, advanced thin finsolar cell modules. | performance of | - | | | - | <u>F</u> | <u>7 2003</u> 1.759 | | <u>FY 2004</u> 2.192 | <u>FY 2005</u> 2.164 |
| | In FY 2003: Flight demonstrated deploym resistant, array of thin film solar cells. Fur thin film solar cells into full arrays. In FY 2004: Demonstrate integration metl | ther integrate 32 | 2 % efficient m | ulti-junction so | olar cells and 10 |)% efficient | | | | | |
| | Complete full space qualification testing or | | | i porymer subs | trates into run a | 11 <i>a</i> ys. | | | | | |
| | In FY 2005: Demonstrate methods for inte | - | | | y-sized thin-film | m blankets. | | | | | |
| (U) | Integrate 28% efficient lattice-mismatch m | iulti-junction so | lar cells into te | st coupons. | | | | | | | |
| (U) | MAJOR THRUST: Develop innovative sp | | al energy stora | ge technologie | s such as the lig | htweight | | 0.888 | | 0.000 | 0.000 |
| (U) | flywheel integrated power and attitude con In FY 2003: Flight demonstrated integrate demonstration system. | • | ol and energy s | torage system. | Developed mi | croflywheel | | | | | |
| (U) | In FY 2004: Not Applicable. | | | | | | | | | | |
| | In FY 2005: Not Applicable. | | | | | | | | | | |
| (U) (U) | MAJOR THRUST: Develop technologies | for long life, ef | ficient, low vib | ration, lightwe | ght mechanica | l cryocoolers | | 1.332 | | 1.348 | 1.274 |
| | for space applications. | | | | | | | | | | |
| | In FY 2003: Developed high capacity mul space-based infrared surveillance and track | | - | | - | solution, | | | | | |
| | ect 682J | 5 | • | - | No. 25-22 of 25-2 | 25 | | | | Exhibit R-2a (F | PE 0603401F) |
| | | | | 399 | | | | | | | / |

| | Exhibit R-2a, RDT&E Project | Justification | | DATE February 2 | 004 |
|------------|--|--|-------|---------------------------------------|-------------|
| | GET ACTIVITY Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology | | NUMBER AND TITLE acecraft Vehicles | |
| (U) | In FY 2004: Investigate protoflight development of high capacity, multi-stage, Develop and characterize performance of second generation design model high advanced space surveillance and tracking sensor. Explore development of com regenerative and recuperative cycle devices to transition enabling technology to In FY 2005: Refine protoflight development of high capacity, multi-stage, low to meet the needs of high resolution, space-based infrared surveillance and trac and optics. Expand development of component cryocooler technologies for reg devices to transition enabling technology to protoflight cryocooler designs. | a capacity 10 Kelvin cryocooler for aponent cryocooler technologies for o protoflight cryocooler designs. A temperature cryocooler technologies cking sensors with larger focal planes | | | |
| (U) (U) | MAJOR THRUST: Develop composites for launch vehicle and spacecraft stru launch vehicle shrouds, thermal protection structures, and space antennas. In FY 2003: Developed spacecraft design to demonstrate multifunctional struc- | ctures technologies. Completed | 1.273 | 3.900 | 1.585 |
| (U) (U) | evaluation of operational grid stiffened structures. Fabricated multifunctional s Completed ground test of full-scale Evolved Expendable Launch Vehicle secon In FY 2004: Refine spacecraft to demonstrate multifunctional structures techn multifunctional spacecraft bus components for small satellites. Flight qualify f Vehicle secondary payload adapter. Explore the design and characterize line Develop large deployable optics structures using nanotechnology-enhanced ma In FY 2005: Further refine spacecraft to demonstrate multifunctional structure | ndary payload adapter structure. ologies. Complete fabrication of full-scale Evolved Expendable Launch ess composite cryogenic tanks. aterials. es technologies. Ground demonstrate | | | |
| (U) (U) | sub-scale linerless composite cryogenic tanks. Fabricate and characterize comp systems using nanotechnology-enhanced materials. MAJOR THRUST: Develop technologies for spacecraft structural controls and such as advanced high power solar array subsystems, sensitive payload isolation | d mechanisms for on-orbit applications | 3.540 | 7.026 | 3.397 |
| (U) | isolation systems. In FY 2003: Developed launch vibration isolation and primary and secondary specific launch vehicle requirements. Flight demonstrated smart passive paylo demonstrated operational active acoustic attenuation system. Flight demonstra system. Integrated low shock separation devices into multiple payload adapter and deployment mechanisms. Completed development of modular vibration-is | ad isolation systems. Ground ted passive acoustic attenuation . Ground demonstrated smart docking | | | |
| (U) | In FY 2004: Refine launch vibration isolation and primary and secondary payl launch vehicle requirements. Flight demonstrate operational active acoustic at low-shock multiple payload adapter technologies. Build deployment and isolar solar array and integrate with thin-film solar cell components. Design flight ha | load isolation systems to meet specific tenuation systems. Flight demonstrate tion mechanisms for large free-flying ardware to demonstrate smart docking | | | |
| Pro | ect 682J R-1 Shopping | List - Item No. 25-23 of 25-25 | | Exhibit R-2a (PE | = 0603401F) |

| Exhibit R-2a, | , RDT&E Project Justification | | DATE February | 2004 |
|--|---|-------------|------------------|-------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603401F Advanced Spacecra Technology | | NUMBER AND TITLE | |
| energy storage. Develop micro-electro-mechanical attitu (U) In FY 2005: Further refine launch vibration isolation and specific launch vehicle requirements. Complete develop Complete development of low-shock multiple payload at smart docking and deployment hardware. Characterize p system with integrated energy storage. Integrate micro-econventional attitude control systems. | d primary and secondary payload isolation systems to meet oment of operational active acoustic attenuation systems. dapter technologies. Perform flight qualification testing of performance of full multi-axis flywheel attitude control | | | |
| | | < 77 | 4.660 | 0.000 |
| arrays. These thin film arrays will be three to five times volume, and be more radiation resistant than state-of-the of amorphous silicon solar cells by increasing cell efficie lightweight polymer substrates. Developed monolithic in film solar cells.(U) In FY 2004: Develop monolithic integration technology | or higher performance, next-generation flexible, thin film solar lighter, cost five times less, require five times less stowed e-art rigid panel arrays. Increased specific power (Watts/kg) ency and developing processes to deposit solar cells on ntegration technology for the low-cost interconnection of thin | 6.772 | 4.660 | 0.000 |
| thin-film solar cells. Demonstrate the reproducible many population of the thin-film solar arrays. | ufacture of large-area amorphous silicon cells necessary for | | | |
| (U) In FY 2005: Not Applicable. | | | | |
| | composite materials to support improved manufacturing and fairing designs. Composite materials decrease primary ring lead times by 50% over conventional metallic structures. and fiber materials for spacecraft adapter and fairing table materials and confirmed unique manufacturing | 2.418 | 2.776 | 0.000 |
| (U) In FY 2004: Further develop efforts to develop larger fa development of design, analysis, and fabrication technique | airings for expendable rockets. This effort focuses on the ues that enable larger fairings to be developed than are ort will refine the design, analysis, and fabrication techniques | | | |
| | | | | |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DA | February | 2004 |
|---------------------------------|---|---------------------------|-----------------|-------------------|---|-------------|----------|----------|-----------------------------------|-------------------|
| | GET ACTIVITY Advanced Technology Develop | oment (ATD) | | | PE NUMBER A 0603401F A Technology | dvanced Spa | cecraft | | MBER AND TITLE | |
| (U) (U) | CONGRESSIONAL ADD: Boron In FY 2003: Not Applicable. In FY 2004: Increase energy conve emissions into electric current. Qu | ersion efficiency of | of the Boron En | | | sotope beta | | 0.000 | 3.470 | 0.000 |
| | In FY 2005: Not Applicable. Total Cost | | | | | | | 17.982 | 25.372 | 8.420 |
| (U) | C. Other Program Funding Sum | <u>mary (\$ in Millio</u> | ons) | | | | | | | |
| (U) (U) (U) (U) (U) | PE 0602203F, Aerospace Propulsion. PE 0602601F, Spacecraft Technology. PE 0603218C, Research and Support. PE 0603226E, Experimental Evaluation of Major Innovative Technologies. PE 0603500F, Multi-Disciplinary Advanced Development Space Technology. This project has been coordinated through the | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| Proj | Not Applicable. | | R- | 1 Shopping List - | Item No. 25-25 of 2 | 25-25 | | | Exhibit R-2a | (PE 0603401F) |

PE NUMBER: 0603444F PE TITLE: MAUI SPACE SURVEILLANCE SYSTEM

| | Exhi | ibit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 |
|------|---|---|---------------------|---------------------|-----------------------------|----------------------|--------------------------|---------------------|----------------------|-------------------------|
| | BET ACTIVITY dvanced Technology Development | (ATD) | | | E NUMBER AND 603444F MAU | TITLE JI SPACE SU | RVEILLANCE | E SYSTEM | i eki dai j | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| | Total Program Element (PE) Cost | 47.130 | 51.581 | 6.306 | 6.323 | 6.405 | 6.513 | 6.617 | Continuing | TBI |
| 4868 | Maui Space Surveillance System | 47.130 | 51.581 | 6.306 | 6.323 | 6.405 | 6.513 | 6.617 | Continuing | TBI |
| . / | A. Mission Description and Budget Ite This program funds technology developer 2004, Congress added \$27 million for the Rapid Response System (Pan-STARRS) This program is in Budget Activity 3, Ac developments that have military utility at | ment at the Maui e MSSS, \$8.5 mil dvanced Technolo | llion for High . | Accuracy Netw | ork Determina | tion System, an | d \$10.2 million | for Panorami | c Survey Telesc | cope And |
| U) | <u>B. Program Change Summary (\$ in M</u> | (illions) | | | | | EX 2002 | | 2004 | EV 2005 |
| U) | Previous President's Budget | | | | | | <u>FY 2003</u> 47.888 | | <u>2004</u> 5.323 | <u>FY 2005</u> 6.323 |
| U) | Current PBR/President's Budget | | | | | | 47.130 | | .525 | 6.306 |
| U) | Total Adjustments | | | | | | -0.758 | | .258 | 0.300 |
| J) | Congressional Program Reductions | | | | | | 0.750 | 15 | .230 | |
|) | Congressional Rescissions | | | | | | | -0 | .442 | |
| | Congressional Increases | | | | | | | | .700 | |
| | Reprogrammings | | | | | | -0.122 | | | |
| | SBIR/STTR Transfer | | | | | | -0.636 | | | |
| U) | Significant Program Changes: | | | | | | | | | |
| | Not Applicable. | | | | | | | | | |
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| | | | | | | | | | | |
| | | | D 1 Sh | opping List - Iten | No. 26 1 of 26 / | 1 | | | Exhibit R-2 (F | |

| | Fxt | nibit R-2a, F | | iect Justif | ication | | | DATE | | |
|------------|---|--|--|---|---|---|---------------------|------------------------------|--------------------------|-------------------------|
| | GET ACTIVITY Advanced Technology Development (| | | - P 0 | PE NUMBER AND 0603444F MAU SURVEILLANG | JI SPACE | | PROJECT NUME 4868 Maui Sp | | 2004 ance System |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| 486 | 8 Maui Space Surveillance System | 47.130 | 51.581 | 6.306 | 6.323 | 6.405 | 6.513 | 6.617 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) (I) | A. Mission Description and Budget Item This program funds technology developm 2004, Congress added \$27 million for the Rapid Response System (Pan-STARRS). This program is in Budget Activity 3, Adv developments that have military utility and B. Accomplishments/Planned Program (19) | ent at the Maui MSSS, \$8.5 mi vanced Technol d address warfig | llion for High ogy Developm | Accuracy Netv | work Determinat | tion System, ar | nd \$10.2 million | n for Panorami | c Survey Teleso | cope And |
| ` ´ | B. Accomplishments/Planned Program (MAJOR THRUST/CONGRESSIONAL A) | | echnology at th | e MSSS in Ha | waii as well as | operate and | | <u>2003</u> 2.288 | <u>FY 2004</u> 32.881 | <u>FY 2005</u> 6.306 |
| | upgrade the facility. In FY 2003: Completed initial design for h completed environmental studies to suppor integrated data architecture for dissemination algorithms for near-real-time post-processin research, development, and operational use resolve electromagnetic interference proble capability enhancements for the radiometer board improvements to the radiometer, enh the spectrograph for non-imaging space obj signatures of space objects. Conducted loss characterize smaller/fainter objects includin In FY 2004: Enhance utility by dedicating upgrade of heavy lift elevator, providing su and maintainability by upgrading network a sites, and procuring critical state-of-the-art post-processed using advanced algorithms secure, near-real-time, web-based connection development efforts using active laser illum demonstrate high precision laser pointing to | t recoating the a on of information on of information on of imagery for rs and visiting e ems at the obsert ancement of hig ject identification t satellite search ong Near-Earth A g specific areas opport to resolve servers at varion spares. Provide for increased the vity for release mination includi | 3.6 meter prima on for MSSS sec- or high interest experimenters to vatory summit es, and spectrog gh order wavef on applications and non-imag Asteroid Tracki to operate at hi e electromagne us classification e automatic fra meliness. Impl of MSSS senso ng high precisi | ary mirror. De ensors. Optimit t objects. Prov using the MSS . Executed reli- graph systems t front compensa . Developed the ting space objection gher classificat tic interference in levels, impro- me selection for ement data dis or information. on range rate of | signed and deve ized use of adva ided technical s S assets. Provid iability improve to include electri- tion, and charac- ne capability to a to tidentification tion levels, cont e at site, enhanci- ving connectivity or daylight imag semination arch Conduct techn data collection a | eloped nced upport to led support to ments and onic and fiber eterization of collect active to detect and inuing the ing reliability ty between ery that is itecture with ology nd | | | | |
| Pro | ject 4868 | | R-1 Sł | opping List - Iter | m No. 26-2 of 26-4 | 1 | | | Exhibit R-2a (I | PE 0603444F) |

| BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND TITLE 03 Advanced Technology Development (ATD) PE NUMBER AND TITLE 4868 Maui Space Surveillance optics system by implementing a tracker upgrade to improve sensitivity and implement diagnostic software capabilities improving resolution. Refurbish MSSS sensors such as the radiometer, long-wave imager, spectrograph, and daylight acquisition sensor for increased sensitivity and resolution. Conduct lost satellite search and non-imaging space object identification to detect and characterize smaller/fainter objects including Near-Earth Asteroid Tracking. (U) (U) In FY 2005: Enhance operational utility by procuring critical sensor and telescope spares, refurbishing the control rooms and upgrading computers for increased personnel efficiency, and maintaining requirements for safety and security in accordance with Air Force regulations. 12.863 10.200 (U) CONGRESSIONAL ADD: Panoramic Survey Telescope And Rapid Response System (Pan-STARRS) 12.863 10.200 (U) In FY 2003: Began design of the telescope system to include the development of advanced charged coupled device detectors, and the hardware/procedures to collect and display the data. Conducted data archiving to support future data collection. 12.863 10.200 (U) In FY 2004: Complete Preliminary Design Review and begin development for telescope system to include the development of advanced charged coupled devices to detect very dim space objects of the 24th magnitude, a telescope system to include the development of advanced charged coupled devices to detect very dim | 04 |
|--|-----------------|
| capabilities improving resolution. Refurbish MSSS sensors such as the radiometer, long-wave imager, spectrograph, and daylight acquisition sensor for increased sensitivity and resolution. Conduct lost satellite search and non-imaging space object identification to detect and characterize smaller/fainter objects including Near-Earth Asteroid Tracking. (U) In FY 2005: Enhance operational utility by procuring critical sensor and telescope spares, refurbishing the control rooms and upgrading computers for increased personnel efficiency, and maintaining requirements for safety and security in accordance with Air Force regulations. (U) (U) CONGRESSIONAL ADD: Panoramic Survey Telescope And Rapid Response System (Pan-STARRS) (U) In FY 2003: Began design of the telescope system to include the development of advanced charged coupled devices to detect very dim space objects of the 24th magnitude, a telescope system that uses the charged coupled device sto detect very dim space objects to detect very dim space objects to detect very dim space and begin development for telescope system to include the development of advanced charged coupled devices to detect very dim space objects to detect very dim space objects to detect very dim space objects of the 24th magnitude, a telescope system to include the development of advanced charged coupled devices to detect very dim space objects of the 24th magnitude, a telescope system to include the development of advanced charged coupled devices to detect very dim space objects of the 24th magnitude, a telescope system to include the development of advanced persones system to include the development of advanced charged coupled devices to detect very dim space objects of the 24th magnitude, a telescope system to include the development of advanced charged coupled devices to detect very dim space objects of the 24th magnitude, a telescope system to include the development of advanced charged coupled devices to detect very dim space objects of t | e System |
| (U) CONGRESSIONAL ADD: Panoramic Survey Telescope And Rapid Response System (Pan-STARRS) (U) In FY 2003: Began design of the telescope system to include the development of advanced charged coupled devices to detect very dim space objects of the 24th magnitude, a telescope system that uses the charged coupled device detectors, and the hardware/procedures to collect and display the data. Conducted data archiving to support future data collection. (U) In FY 2004: Complete Preliminary Design Review and begin development for telescope system to include the development of advanced charged coupled devices to detect very dim space objects of the 24th magnitude, a telescope system to include the development of advanced charged coupled devices to detect very dim space objects of the 24th magnitude, a telescope system to include the development of advanced charged coupled device detectors, and the hardware/procedures to collect and display the data. | |
| development of advanced charged coupled devices to detect very dim space objects of the 24th magnitude, a telescope system that uses the charged coupled device detectors, and the hardware/procedures to collect and display the data. | 0.000 |
| Design and develop data archiving to support future data collection. (U) In FY 2005: Not Applicable. | |
| (U) (U) CONGRESSIONAL ADD: High Accuracy Network Determination System (HANDS). (U) In FY 2003: Demonstrated use of HANDS for high accuracy orbit prediction, non-imaging signatures, and studied the possibilities of use for low resolution imaging. (U) In FY 2004: Deploy additional HANDS sensors in areas of high interest in the Space Surveillance Network and study use of system for detecting and tracking objects in low-earth orbit. Develop large field of view acquisition telescope. (U) In FY 2005: Not Applicable. | 0.000 |
| (U) Total Cost 47.130 51.581 | 6.306 |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> <u>FY 2003</u> <u>FY 2004</u> <u>FY 2005</u> <u>FY 2006</u> <u>FY 2007</u> <u>FY 2008</u> <u>FY 2009</u> <u>Cost to</u> <u>Actual Estimate</u> <u>Estimate</u> <u>Estimate</u> <u>Estimate</u> <u>Estimate</u> <u>Estimate</u> <u>Estimate</u> <u>Estimate</u> <u>Estimate</u> <u>Complete</u> (U) Related Activities: | <u>tal Cost</u> |
| (U) Related Activities. (U) PE 0602605F, Directed Energy Technology. (U) PE 0603605F, Advanced | |
| Project 4868 R-1 Shopping List - Item No. 26-3 of 26-4 Exhibit R-2a (PE 0 405 405 | 603444F) |

| Exhibit R-2a, RI | DT&E Project Justification | DATE February 2004 | | | |
|--|--|----------------------------|--|--|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | hnology Development (ATD) PE NUMBER AND TITLE SURVEILLANCE SYSTEM | | | | |
| (U) C. Other Program Funding Summary (\$ in Millions) Weapons Technology. PE 0602500F, (U) Multi-Disciplinary Space Technology. PE 0603500F, (U) Multi-Disciplinary Advanced Development Space Technology. (U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate | | | | | |
| duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. | | | | | |
| Project 4868 | R-1 Shopping List - Item No. 26-4 of 26-4 | Exhibit R-2a (PE 0603444F) | | | |

PE NUMBER: 0603500F PE TITLE: MULTI-DISCIPLINARY ADV DEV SPACE TEC

| | Exhib | it R-2, RDT | F&E Budge | t Item Just | ification | | | DATE | February | 2004 |
|------|--|-------------|-----------|-------------|--------------|----------------------------------|------------|------------|------------|-------|
| | r ACTIVITY vanced Technology Development (/ | ATD) | | | E NUMBER AND |) TITLE L TI-DISCIPLII | NARY ADV D | EV SPACE T | EC | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ III MIIIIOIIS) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| | Total Program Element (PE) Cost | 51.688 | 62.077 | 51.114 | 59.564 | 76.337 | 81.755 | 73.055 | Continuing | TBD |
| 5031 | Advanced Optics & Laser Space Tech | 14.012 | 19.437 | 19.158 | 22.755 | 25.303 | 26.800 | 27.814 | Continuing | TBD |
| 5032 | Advanced Space Materials | 6.381 | 11.615 | 0.000 | 0.000 | 5.813 | 5.316 | 3.909 | Continuing | TBD |
| 5033 | Rocket Propulsion Demonstration | 24.369 | 22.032 | 22.437 | 28.155 | 30.710 | 32.714 | 33.239 | Continuing | TBD |
| 5034 | Advanced Space Sensors | 4.511 | 6.018 | 9.519 | 8.654 | 11.605 | 16.055 | 7.633 | Continuing | TBD |
| 5062 | Advanced Structures for Space Vehicles | 2.415 | 2.975 | 0.000 | 0.000 | 2.906 | 0.870 | 0.460 | Continuing | TBD |

Note: In FY 2003 this was a new PE, but not a New Start, resulting from the Space Commission recommendation to consolidate all space unique activities. In FY 2003, only the space unique tasks in the following PEs/Projects transferred to this PE in conjunction with the Space Commission recommendation: PE 0603605F, Projects 3150 and 3647, to Project 5031; PE 0603112F, Projects 2100 and 3946, to Project 5032; PE 0603216F, Project 4922, to Project 5033; and PE 0603203F, Project 665A/PE 0603270F, Projects 431G and 691X, to Project 5034. In FY 2004, efforts in Project 5062, will be complete until FY 2007 when efforts will commence to define spacelift vehicles using the results of the hypersonic engine studies in PE 0602500F, Multi-Disciplinary Space Technology, Project 5027.

(U) <u>A. Mission Description and Budget Item Justification</u>

This program develops and demonstrates multi-disciplinary space technologies in five projects, each focusing on a separate technology area. 1) Advanced optics and laser space technology demonstrates and assesses space unique advanced optics and high energy laser weapon systems capabilities. 2) Advanced space materials develop and demonstrate materials and processing technologies for future space vehicle components and protection of space sensors from a variety of laser threats. 3) Rocket propulsion develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques for launch and spacecraft applications. 4) Advanced space sensors develops and demonstrates sensor technologies for intelligence, surveillance, and reconnaissance, communications, targeting, and electronic counter-countermeasures for spacecraft applications. 5) Advanced structures for space vehicles develop space unique requirements of a horizontal launched Transatmospheric vehicle operating in an extreme environment.

R-1 Shopping List - Item No. 27-1 of 27-18

| Exhibit R-2, RDT&E Bu | dget Item Justification | | DATE February 2004 | | |
|---|--|------------|-----------------------|-----------------|--|
| UDGET ACTIVITY 3 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY | ADV DEV SI | | | |
| U) <u>B. Program Change Summary (\$ in Millions)</u> | | | | | |
| | FY 20 | 03 | FY 2004 | <u>FY 200</u> : | |
| U) Previous President's Budget | 54.1 | | 62.610 | 55.81 | |
| J) Current PBR/President's Budget | 51.6 | | 62.077 | 51.11 | |
| J) Total Adjustments | -2.4 | | -0.533 | | |
| U) Congressional Program Reductions | | | | | |
| Congressional Rescissions | | | -0.533 | | |
| Congressional Increases | | | 0.000 | | |
| Reprogrammings | -0.1 | 60 | | | |
| SBIR/STTR Transfer | -2.3 | | | | |
| J) <u>Significant Program Changes:</u> | 2.3 | 15 | | | |
| | | | | | |
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R-1 Shopping List - Item No. 27-2 of 27-18

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justi | fication | | | DATE | February | 2004 |
|----------------------------|--|--|---|--|--|--|----------------|----------|----------------|-------------------------|
| | ET ACTIVITY dvanced Technology Development (| ATD) | | | PE NUMBER AND 0603500F MUL DEV SPACE T | TI-DISCIPLI | NARY ADV | | BER AND TITLE | Laser Space |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ III MIIIIOIIS) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 5031 | Advanced Optics & Laser Space Tech | 14.012 | 19.437 | 19.158 | 3 22.755 | 25.303 | 26.800 | 27.814 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | (| | 0 | 0 | * | | |
| consc (U) (U) (U) | In FY 2003, space unique tasks in PE 060 lidate all space unique activities. A. Mission Description and Budget Item This project demonstrates and conducts de B. Accomplishments/Planned Program (MAJOR THRUST: Perform directed energy space control and space situational awarene In FY 2003: Provided data to U.S. Space (| n Justification etailed assessme \$ in Millions) gy and space en ess requirement | ent of space un vironment asse s. | ique technolo essments on sa | gies needed for a atellites in suppor | dvanced optica | al systems and | - | | <u>FY 2005</u> 0.000 |
| (U) (U) (U) | Finite state models with other satellite data picture. In FY 2004: Not Applicable. In FY 2005: Not Applicable. | and observable | s to produce a r | more complet | e space situation: | al awareness | | | | |
| (U) (U) | MAJOR THRUST: Develop and demonstr advanced adaptive optics, beam control, lar control, spacecraft and optical control integ In FY 2003: Developed system concepts a mirrors to advance global strike, global pre Quantified the performance of a membrane space membrane mirror experiment. Devel In FY 2004: Develop laser relay mirror co global presence, and ballistic missile defen simulation tools for relay mirrors. In FY 2005: Developing critical optical tec system for developmental and field tests an | rge lightweight gration, beam st nd design techr sence, and ball mirror coated loped modeling ncepts and desi se capabilities f | optics, optical abilization, and ology demons- stic missile de- with a high-ene and simulation gn technology for the warfight egrate mature t | coatings, thro d jitter control trations of las fense capabili ergy laser diel n tools for spa demonstration ter. Further d echnologies of | ughput, dual line er relay mirrors a ties for the warfi lectric coating an ace-based relay m ns to advance glo evelop modeling | of sight nd membrane ghter. d designed a iirrors. bal strike, and elay mirror | | 1.228 | 5.172 | 3.670 |
| (U) | ultra-light mirror space demonstration expension expension of the space of the spac | | eam control ex | periments for | applications incl | uding | | 7.926 | 4.229 | 4.618 |
| Proie | ect 5031 | | R-1 Sh | opping List - Ite | em No. 27-3 of 27-1 | 8 | | | Exhibit R-2a (| PE 0603500F) |
| | | 1 | | 40 | | | | | | / |

| Exhibit R-2a, RDT&E Project Justification | | DATE February | 2004 |
|---|--|--------------------|---------------|
| BUDGET ACTIVITY PE NUMBER AND TITL 03 Advanced Technology Development (ATD) 0603500F MULTI-I DEV SPACE TEC | | T NUMBER AND TITLE | |
| antisatellite weapons, relay mirror systems, satellite tests and diagnostics, and high-resolution satellite imag (U) In FY 2003: Performed beam pointing and guidestar radiometry (for atmospheric compensation) tests using sodium-wavelength laser beacon. Designed and began integration of full aperture point-ahead atmospheric compensation system for low-power laser projection to satellites on weapons-class beam director (3.5 meter telescope). Demonstrated high-accuracy active satellite tracking on 3.5 meter telescope with simultaneous compensated satellite imaging and compensated laser projection to a low-earth-orbit satellite (integrated beat demonstration). (U) In FY 2004: Complete integration and begin testing of full aperture point-ahead atmospheric compensation for low-power laser projection to satellites on weapons-class beam director (3.5-meter telescope). (U) In FY 2005: Complete integration and testing of sodium-beacon adaptive optics system including compensation infrared imaging of low earth orbit satellites. Integrate hybrid-beacon full aperture point-ahead atmospheric compensation system on 3.5-meter telescope. | g a r am control system ated | | |
| (U) (U) MAJOR THRUST: Develop and demonstrate optical technologies for high bandwidth ground-to-air comm (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop advanced modular deformable mirrors and adaptive optical control systems. Develop optical filters, infrared sensors, and signal processing systems. Begin design of communications breadboard automated ground stations. (U) In FY 2005: Develop and build advanced modular deformable mirrors and adaptive optical control systems advanced optical filters, infrared sensors, and signal processing systems. Develop a portable enclosure system optical ground terminal. | o advanced d for s. Develop | 10.036 | 10.870 |
| (U) (U) CONGRESSIONAL ADD: Aerospace Relay Mirror System. (U) In FY 2003: Developed technologies for an aerospace (airborne) relay mirror testbed. Developed and enhat techniques for dual line of sight control via a coude path and two separate telescopes. Developed, matured, integrated beam control, optical, and platform hardware to provide risk reduction for a full-scale relay mirror Developed a point design for the optical system and control system, and integrated with all subsystems. Ta integrated point-ahead beacon technology into the testbed. (U) In FY 2004: Not Applicable. | and or system. | 0.000 | 0.000 |
| (U) In FY 2005: Not Applicable.(U) Total Cost | 14.012 | 19.437 | 19.158 |
| Project 5031 R-1 Shopping List - Item No. 27-4 of 27-18 | | Exhibit R-2a | (PE 0603500F) |

| | Exhibit R- | 2a, RDT&E | Project Ju | stification | | | I | DATE February | / 2004 |
|--|---------------------------|---------------------|----------------------------|--|-----------------------------------|--|-----------------------|------------------|-------------------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | | | | PE NUMBER A 0603500F N DEV SPACE | | DJECT NUMBER AND TITLE 31 Advanced Optics & Laser Spac | | | |
| (U) <u>C. Other Program Funding Sun</u> | <u>nmary (\$ in Milli</u> | <u>ons)</u> | | | | | | | |
| PE 0602500F, (U) Multi-Disciplinary Space Technology. PE 0602605F, Directed Energy Technology. (U) PE 0603444F, Maui Space Surveillance System. (U) PE 0603605F, Advanced Weapons Technology. (U) Defense Boost Phase Segment. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) D. Acquisition Strategy Not Applicable. | FY 2003 Actual | FY 2004 Estimate | <u>FY 2005</u> Estimate | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 20</u> Estin | | <u>Total Cost</u> |
| Project 5031 | | R | R-1 Shopping List | - Item No. 27-5 of 2 | 7-18 | | | Exhibit R-2a | (PE 0603500F) |

| | Exi | hibit R-2a, I | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|--|--|---|---|---|---|---|--|---|---|---|
| | GET ACTIVITY dvanced Technology Development (| (ATD) | | C | PE NUMBER AND 0603500F MUI DEV SPACE T | _TI-DISCIPLI | | PROJECT NUME 5032 Advanc | BER AND TITLE ed Space Ma | terials |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| 5032 | 2 Advanced Space Materials | 6.381 | 11.615 | 0.000 | | 5.813 | 5.316 | 3.909 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | In FY 2003, space unique tasks in PE 060 blidate all space unique activities. In FY 20 A. Mission Description and Budget Iter This project develops and demonstrates n up to the appropriate level to demonstrate demonstrated to validate expected materia system design decisions. Laser hardened of laser threats. Reducing risk in materia | 005, efforts in the n Justification naterials and process materials capal als characteristic materials techn | nis project will ocessing techno pility in the rela cs. Critical dat ologies are dev | be delayed unt blogies for trans ative environm ta on both struc veloped, demor | til FY 2007 due sition into Air F lent. Subscale c ctural and nonstr nstrated, and tran | to higher Air I Force space sys omponents and ructural materia nsitioned for th | Force priorities. tems. Material I nonstructural als is developec e broadband pr | s and processes material compo l and provided rotection of spa | s development i onents are deve for engineering ice sensors fron | s scaled loped and and a variety |
| (U) | systems. B. Accomplishments/Planned Program (| | iproves the arr | ordability, ienz | ability, sui vivab | anty, and opera | - | <u>2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| (U) (U) (U) (U) (U) (U) (U) (U) | MAJOR THRUST: Develop and demonst subsystems to provide enhanced surveillan affordability of space vehicles. In FY 2003: Completed the demonstration performance, and producible infrared detect processing technologies to improve affordate exposure on advanced material systems. In FY 2004: Not Applicable. In FY 2005: Not Applicable. MAJOR THRUST: Develop and demonst Force spacecraft sensors to ensure safety, se In FY 2003: Identified and evaluated optice infrared staring focal plane arrays. In FY 2004: Develop optical limiter material plane arrays. In FY 2005: Not Applicable. | ace capabilities, a of improved m ctor materials. Y ability of spaced rate advanced n survivability, an cal limiter mater | improved acce naterial process Validated and c craft componen naterials techno d operability in rials for the pro | ess to space, and ses with increas demonstrated n hts. Validated n blogies that enh n a laser threat otection of near | d improved over sed yields for ro naterials and ma measured effects nance laser hard environment. r-infrared to sho | rall bust, high tterials s of space ening of Air rt-wave | | 1.420 1.320 | 0.000 | 0.000 |
| | ect 5032 | | R-1 Sh | ionnina List - Iten | n No. 27-6 of 27-1 | 8 | | | Exhibit R-2a (I | PE 0603500E) |
| 110 | | | | 412 | | ~ | | | | |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|--|---|---|---|--|--|-----------------------------------|-----------------------------------|-----------------------------------|-------------------|
| BUDGET ACTIVITY 03 Advanced Technology Develor | oment (ATD) | | | PE NUMBER A 0603500F N DEV SPACE | IULTI-DISCIPL | INARY ADV | | BER AND TITLE ced Space Ma | terials |
| (U) MAJOR THRUST: Develop and or revolutionary improvements in the (U) In FY 2003: Identified and evalual large, lightweight, potentially load characterized ceramic and organicand weapon leading edges. (U) In FY 2004: Develop ceramic-bas shapes for load bearing structures in components. Initiate materials and components. Initiate materials and components. | performance of a ted cryogenic flui bearing tank stru based composite ed materials (mor n space access sy | ir breathing and d compatible m ctures for air-br materials for du nolithic and com stems and static | d rocket-based ac aaterial and affor eathing and rock arable, very high posite) capable c turbine-based c | erospace vehicle dable processing et-based vehicle temperature aer of being process ombined cycle a | s and weapons. g technologies fo es. Evaluated an ospace vehicle eed into complex and scramjet | d | 3.641 | 9.839 | 0.000 |
| launch vehicles. Develop, character temperature protection systems in a high temperature protection seals. structures and propulsion system c compatibility, and durability. Den coatings coupled with advanced re reentry vehicles and high-Mach ve and hydrocarbon environments for protection for sensor and payload i (U) In FY 2005: Not Applicable. (U) Total Cost | erize and evaluate reusable high-spe Develop and asse omponents empha nonstrate innovati fractory composit hicles. Develop a air-breathing and | e ceramic-based ed systems, esp ess metallic mat asizing increase ve material com- es, for high-ten analytical mode l rocket-based v | materials (mono ecially for leadin erials (monolithi d operating temp cepts, such as ab operature protect ling tools to prec- rehicles. Develo | olithic and comp ing edges, control ic and composite perature, environ lative and oxida ion system leadi lict material beh p and assess jam | osite) for high surfaces, and for space acces mental tion - protection ng edges for avior in cryogen | ss | 6.381 | 11.615 | 0.000 |
| (U) C. Other Program Funding Sum | mary (\$ in Milli | ons) | | | | | 0.501 | 11.015 | 0.000 |
| | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> Estimate | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> Estimate | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| (U) PE 0602102F, Materials. PE 0602500F, | | | | | | | | | |
| (U) Multi-Disciplinary Space Technology. | | | | | | | | | |
| (U) PE 0603112F, Advanced Materials for Weapon Systems. | | | | | | | | | |
| This project has been coordinated through the Reliance process to harmonize efforts and eliminate | | | | | | | | | |
| Project 5032 | | F | R-1 Shopping List - | Item No. 27-7 of 2 | 27-18 | | | Exhibit R-2a (I | PE 0603500F) |

| | Exhibit R-2a, RD | T&E Project Justification | DATE February 2004 |
|-----|--|--|--------------------------|
| | OGET ACTIVITY Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY AD DEV SPACE TEC | PROJECT NUMBER AND TITLE |
| (U) | <u>C. Other Program Funding Summary (\$ in Millions)</u> | | |
| | duplication. | | |
| (U) | D. Acquisition Strategy Not Applicable. | | |
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| | | | |
| | | | |
| Pro | oject 5032 | R-1 Shopping List - Item No. 27-8 of 27-18 | Exhibit R-2a (PE 06035 |

| BUDGE | Fyl | nibit R-2a, F | | iect Justifi | ication | | | Ľ | DATE | | |
|---|---|---|---|---|---|---|---|---|---|--|--|
| | T ACTIVITY vanced Technology Development (| - | | - P 0 | E NUMBER AND 603500F MUI DEV SPACE T | _TI-DISCIPLII | NARY ADV | February 2004 PROJECT NUMBER AND TITLE 5033 Rocket Propulsion Demonstration | | | 2004 |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 20 | | | Total |
| 5000 | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estima | | | |
| 5033 | Rocket Propulsion Demonstration | 24.369 | 22.032 | 22.437 | 28.155 | 30.710 | 32.714 | 1 | 3.239 Conti | nuing | TBD |
| NT 1 | Quantity of RDT&E Articles In FY 2003, space unique tasks in PE 060 | | 0 | 0 | 0 | 0 | 0 | | 0 | | |
| (U) A T a S e to T T o v c | A. Mission Description and Budget Item This project develops and demonstrates ac and advanced propellants for launch and of Systems Phase 1. Characteristics such as emphasized. Increased life and performan technologies for stationkeeping and on-or- propulsion systems, higher efficiency ener Fechnological advances developed in this operations, and support costs by ~30 perco- will also lead to seven-year increase in satellite Department of Defense, National Aeronau | dvanced and inr orbit transfer pro- environmental nee of propulsion bit maneuvering rgy conversion program will in ent. Responsivitellite on-orbit t e payload. The | opulsion. Addi acceptability, a n systems are l g applications. systems (derive nprove the per- reness and oper ime, a 50 perce efforts in this p | tionally, this p ffordability, re key goals. This Technology ar ed from an imp formance of ex rability of prop ent increase in s project contribu | roject develops liability, resports s project also de reas investigated proved understa pendable system ulsion systems satellite maneurs te to the Integr | technologies for asiveness, reduce evelops chemic d include groun nding of combu- ms' payload cap will be enhance vering capabilit ated High Payo | or the Technol eed weight, an al, electrical, a ad demonstrati astion fundam pabilities by ~ ed for reusable y, a 25 percent off Rocket Pro | ogy for Su d reduced and solar re ons of con entals), and 20 percent e launch sy t reductior pulsion Te | astainment of a operation and ocket propulsi npact, lightwe d high-energy , reduce the la rstems. Techn n in orbit trans echnology prog | Strateg launch on syst ight, ac propel unch, ology a fer ope gram, a | ic n costs are tem dvanced lants. advances erational |
| | . Accomplishments/Planned Program (| | | | | | | | | ii need. | - |
| (U) M (U) In Da (U) In hy reu (U) In an sta | IAJOR THRUST: Develop liquid rocket a FY 2003: Tested turbopumps for integra emonstration. Completed redesign and an a FY 2004: Complete integration of comp ydrogen-based engine technologies. Initia susable launch vehicle concepts. a FY 2005: Complete testing for the Integ- nalyses of hydrocarbon demonstration for age technologies including higher efficier | propulsion tech ation into an ad nalysis of advar ponents for the l ate component of grated Powerhea reusable launcl | vanced hydrog need hydrocarb Integrated Pow designs and ana nd Demonstrati n vehicle conce | en engine for th on engines. erhead Demon alyses of hydro on. Enhance c epts. Scale-up a | he Integrated Po stration of adva carbon demons omponent desig | owerhead nced, long life, tration for gns and | | <u>7 2003</u> 11.176 | <u>FY 200</u> 15.02 | <u>)4</u> | - |
| (U) M (U) In (U) In hy re (U) In an sta (U) (U) (U) M sta | IAJOR THRUST: Develop liquid rocket a FY 2003: Tested turbopumps for integra emonstration. Completed redesign and an a FY 2004: Complete integration of comp ydrogen-based engine technologies. Initia cusable launch vehicle concepts. a FY 2005: Complete testing for the Integ- nalyses of hydrocarbon demonstration for | propulsion tech ation into an ad nalysis of advar ponents for the l ate component of grated Powerhea reusable launch ncy energy conv and solar electro ormation flying | vanced hydrog need hydrocarb Integrated Pow designs and ana ad Demonstration vehicle conce- version systems ric propulsion t , station keepir | en engine for th on engines. erhead Demon- alyses of hydro on. Enhance c epts. Scale-up a s ecchnologies fo ng, and repositi | he Integrated Po stration of adva carbon demons omponent desig advanced cryog r existing and f oning. | owerhead inced, long life, tration for gns and genic upper uture upper | | | | <u>)4</u> 20 | s. <u>FY 2005</u> |

| | Exhibit R-2a, RDT&E Project Just | ification | | DATE February | 2004 |
|------------|---|---|--|------------------|-------------|
| | GET ACTIVITY Advanced Technology Development (ATD) | 5033 R | T NUMBER AND TITLE ocket Propulsion stration | | |
| (U) (U) | Hall thrusters capable of low-earth orbit to geosynchronous-earth-orbit transfer. Prep small satellite propulsion demonstration unit for a microsatellite demonstration suppo Air Force imaging requirements. Begin next phase solar thermal demonstration. In FY 2005: Advance development of electric propulsion systems for orbit-transfer b thrusters capable of low-earth orbit to geosynchronous-earth-orbit transfer. Complete satellite propulsion demonstration unit for a microsatellite demonstration. Enhance so | e of low-earth-orbit to atellite propulsion ging requirements. fer by developing high-power are for delivery of the advanced rting improved capability for y developing high-power Hall delivery of the advanced small olar electric/thermal technology | | | |
| (U) | developments improving power efficiency and thruster efficiency. Begin component thruster demonstration. | integration for a high power Hall | | | |
| | MAJOR THRUST: Develop missile propulsion, aging, and surveillance technology f Missile to include demonstration of missile propulsion technology and Post Boost Co support Technologies for the Sustainment of Strategic Systems Program - Phase 1. | | 3.360 | 1.490 | 6.468 |
| (U) | In FY 2003: Demonstrated PBCS component technologies with available materials to maintain system performance. Tested strategic sustainment demonstration technologies propellant, case, and nozzle technologies and demonstrated cost and performance goa | es that integrated advanced | | | |
| | In FY 2004: Begin fabrication of final PBCS components for testing and demonstrati (to include propellant, case, and nozzle) for the interim strategic sustainment demonst | on. Fabricate final components ration motors. | | | |
| (U) | In FY 2005: Complete fabrication of components for the Post Boost Control demonst fabrication and begin integration and testing for the interim strategic sustainment dem assessment and fabrication of the final strategic sustainment demonstration motors. | - | | | |
| (U) | | | | | |
| | MAJOR THRUST: Develop electric and advanced chemical based monopropellant p future satellite propulsion systems. | ropulsion technologies for | 0.373 | 1.922 | 2.021 |
| (U) | In FY 2003: Completed brassboard level testing of a pulsed plasma thruster system. testing of the thruster integrated with the power-processing unit. Enhanced developm Force small satellites required for key Air Force Space Command concepts. Complet verification testing of flight hardware for microsatellite demonstration spacecraft. | ent of propulsion system for Air | | | |
| (U) | In FY 2004: Demonstrate pulsed plasma thruster. Complete development of propuls satellites required for key Air Force Space Command Concepts. Develop advanced n | • | | | |
| Dre | bject 5033 R-1 Shopping List - Ite | 1 1 0 | | Exhibit R-2a (F | |
| FIC | | | | | L 0003000F) |

| | | | | | | | | | DATE | |
|--|--|--------------------------------------|--------------------------------------|-----------------------------------|--|-----------------------------------|-----------------------------------|----------------------|--|-------------------|
| | | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | | February | 2004 |
| | GET ACTIVITY Advanced Technology Developm | nent (ATD) | | | PE NUMBER A 0603500F M DEV SPACE | ULTI-DISCIPL | INARY ADV | 5033 Ro | FNUMBER AND TITLE Docket Propulsion Stration | |
| (U) | propulsion ground demonstration. In FY 2005: Demonstrate pulsed pla satellites required for key Air Force S propulsion ground demonstration. | Space Comman | d Concepts. De | velop advanced i | monopropellant | and begin vehic | le | 6.097 | | |
| | MAJOR THRUST: Evaluate reusablengines. | 0.000 | 0.000 | | | | | | | |
| (U) | In FY 2003: Evaluated reusable hyd cycle engines. Components evaluate Phase II hydrocarbon boost demonstr into combined cycle engine developr In FY 2004: Not Applicable. In FY 2005: Not Applicable. | ed were consiste ration in FYs 20 | nt with Integrate 005-2006. Deter | ed High Payoff F | Rocket Propulsion nt technologies | on Technology to be integrated | | | | |
| · / | Total Cost | | | | | | | 24.369 | 22.032 | 22.437 |
| (U) (U) (U) (U) (U) (U) | C. Other Program Funding Summ PE 0602102F, Materials. PE 0602203F, Aerospace Propulsion. PE 0602500F, Multi-Disciplinary Space Technology. PE 0602601F, Spacecraft Technology. PE 0603114N, Power Projection Advanced Technology. PE 0603216F, Aerospace Propulsion Power Technology. PE 0603401F, Advanced Spacecraft Technology. | FY 2003 Actual | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | FY 2007 Estimate | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2</u> Estir | | <u>Total Cost</u> |
| . , | PE 0603853F, Evolved ject 5033 | | R- | 1 Shopping List - If | tem No. 27-11 of 2 | 27-18 | | | Exhibit R-2a | (PE 0603500F) |
| _ | | | | | 117 | | | | | |

| Exhibit R-2a, RDT&E P | DATE | | |
|--|--|---------------|--|
| | | February 2004 | |
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | 0603500F MULTI-DISCIPLINARY ADV | 5033 R | T NUMBER AND TITLE ocket Propulsion Instration |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Expendable Launch Vehicle Program. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate | | | |
| duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| Project 5033 R-1 S | hopping List - Item No. 27-12 of 27-18 | | Exhibit R-2a (PE 0603500F |

| | Ex | hibit R-2a, I | RDT&E Pro | ject Justif | fication | | | DATE | February | 2004 |
|-------------------|---|--|--|--|---|---|---------------|-----------------------------|-------------------------|-------------------------|
| | ET ACTIVITY dvanced Technology Development | (ATD) | | | PE NUMBER AND 0603500F MUI DEV SPACE T | LTI-DISCIPLI | | PROJECT NUME 5034 Advanc | BER AND TITLE | nsors |
| | Cost (\$ in Millions) FY 2003 Actual FY 2004 Estimate FY 2005 Estimate FY 2006 Estimate FY 2007 Estimate FY 2008 Estimate FY 2008 Estimate 034 Advanced Space Sensors 4.511 6.018 9.519 8.654 11.605 16.055 Quantity of RDT&E Articles 0 0 0 0 0 0 0 ote: In FY 2003, space unique tasks in PE 0603203F, Project 665A, and PE 0603270F, Projects 431G and 691X, transferred into this project in commission recommendation to consolidate all space unique activities. A.Mission Description and Budget Item Justification This project develops and demonstrates space sensor technologies, including radio frequency sensors; intelligence, surveillance, and recommand | | | FY 2009 | Cost to | Total | | | | |
| 5024 | Cost (\$ in Millions) Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete 034 Advanced Space Sensors 4.511 6.018 9.519 8.654 11.605 16.055 7.633 Continui Quantity of RDT&E Articles 0 | | | | | | | | | |
| 3034 | • | | | | | | | | Continuing | TBD |
| Note | | ÷ | - | | * | | * | * | ction with the | Snace |
| (U) | <u>A. Mission Description and Budget Ite</u> This project develops and demonstrates sensors; laser warning sensors; targeting | em Justification space sensor tech and attack radar M technologies | nnologies, inclu sensors; and e for space applic | lectronic count cations, this pr | ter-countermeas oject provides s | ures (ECCM) a pace platforms | and communica | tions. By deve | eloping multi-fu | inction |
| (U) | B. Accomplishments/Planned Program MAJOR THRUST: Develop a material spaint/camouflage thermal reflectance feat | (\$ in Millions) ignature analysis | capability to e | valuate the ph | ysical/chemical | origins of | | <u>2003</u> 0.283 | <u>FY 2004</u> 0.323 | <u>FY 2005</u> 0.194 |
| (U) (U) (U) | measurements. In FY 2003: Performed chemical analyse validated a baseline predictive signature p In FY 2004: Develop a forward predictiv analyses of an expanded target set and con- environmental influences on spectral sign In FY 2005: Expand the development of Develop an enhanced system-level model the addition of polarimetric signatures. | prediction model re capability valiontinue developin atures. material signature | for space-quali dated with emp g an enhanced re analysis rese | fied hyperspectified measure surface scatter arch into the a | ctral electro-opti ments. Perform ring model. Ass rea of polarimet | ical sensors. chemical ess ric signatures. | | | | |
| | MAJOR THRUST: Develop and demons resistance, positional accuracy, timing acc combat capabilities. | curacy, and explo | oitation techniq | ues to improve | e offensive and | defensive | | 0.951 | 1.020 | 2.362 |
| | In FY 2003: Designed advanced M-Code to provide precise time, position, and velo improved assessment of GPS anti-jam tec | ocity for multiple | e platforms. De | emonstrated vir | rtual flight test t | echnology for | | | | |
| | In FY 2004: Design direction finding tec enhanced offensive and defensive combat | - | - | | - | - | | | | |
| Proj | ect 5034 | | R-1 Sho | opping List - Item | n No. 27-13 of 27- | 18 | | | Exhibit R-2a (I | PE 0603500F) |
| | | | | 419 | 9 | | | | | |

| | Exhibit R-2a, RDT&E Proje | DATE February | DATE February 2004 | | |
|------------|--|---|-----------------------|--------------|---------------|
| | GET ACTIVITY Advanced Technology Development (ATD) | Advanced Space Se | ensors | | |
| (U) | time, position, and velocity for on-board and off-board platform applications technology to assess anti-jam Global Positioning System (GPS) III techniqu In FY 2005: Demonstrate assured reference technologies to provide precise and off-board platform applications. Demonstrate antenna wavefront simula III techniques. | es. time, position, and velocity for on-board | | | |
| (U) | | | | | |
| (U) | MAJOR THRUST: Develop and demonstrate advanced wide-band electron encoding/pre-processing/sorting concepts and techniques to handle increasing signal environment for applications in existing and future space EC systems | ng digitization of the modern complex RF | 0.430 | 0.000 | 0.000 |
| | In FY 2003: Developed requirements analysis and hardware and software d systems. | | | | |
| | In FY 2004: Not Applicable. | | | | |
| | In FY 2005: Not Applicable. | | | | |
| (U) (U) | MAJOR THRUST: Develop space-based support jamming technologies and radio frequency threats. | d techniques that will counter advanced | 1.430 | 0.000 | 0.000 |
| (U) | In FY 2003: Completed study of and continued developing and assessing pl space-based support jamming technologies in space unique environments. | hysical requirements for applying | | | |
| ധ | In FY 2004: Not Applicable. | | | | |
| | In FY 2005: Not Applicable. | | | | |
| (U) | 11 | | | | |
| (U) | MAJOR THRUST: Develop space laser warning sensor technologies for ti acquisition/tracking sensors, including detecting and locating both high pow (laser-guided ordnance) signals. | - | 1.417 | 0.559 | 1.111 |
| (U) | In FY 2003: Completed design of space-hardened processor, geolocation, a false alarm package hardware and began integration onto flight platform. C Performed risk reduction analysis for space-hardened geolocation, spectrom | ompleted false alarm test planning. | | | |
| | initial components of space laser warning sensor modules. | ····· F····· | | | |
| (U) | In FY 2004: Integrate false alarm package for space flight. Breadboard geo processor modules. Complete fabrication of space-qualified false alarm sen | | | | |
| (U) | In FY 2005: Complete designs for space-qualified laser warning sensors for laser designators, trackers, dazzlers, and weapons. Develop geolocation, space- | r rapid detection and characterization of ectrometer, and algorithm processor | | | |
| | modules, and integrate false-alarm reduction techniques in preparation for space qualified false alarm concer modules. Exprise and integrate space | | | | |
| | of space-qualified false-alarm sensor modules. Fabricate and integrate space | · · · · · | | | |
| Pro | oject 5034 R-1 Shoppi | ing List - Item No. 27-14 of 27-18 420 | | Exhibit R-2a | (PE 0603500F) |

| | | Evhibit P | | Project Jus | tification | | | | DATE | |
|-----|---|--------------------|------------------|--|--------------------|-----------------|---|-------------|---------------------------|-------------------|
| | | | Za, RDIQE | Froject Jus | | | | | February | |
| | GET ACTIVITY Advanced Technology Develo | | | PE NUMBER A 0603500F M DEV SPACE | ULTI-DISCIPL | INARY ADV | PROJECT NUMBER AND TIT 5034 Advanced Space | | | |
| | engineering test unit. Develop me testing, data collection, and system | | l, and functiona | l interfaces to a l | nost satellite. Pl | an for on-orbit | | | | |
| (U) | | | | | | | | | | |
| (U) | MAJOR THRUST: Develop adv network-level topology for Airbor | 0.000 | 4.116 | 5.852 | | | | | | |
| | In FY 2003: Not Applicable. | | | | | | | | | |
| (U) | In FY 2004: Integrate and test ele | - | - | - | • | | n | | | |
| | testbed, and evaluate performance lengths. Define requirements for | - | | | | • • | | | | |
| | Develop aircraft optical network t | | | - | - | · · | | | | |
| | lower level radio frequency system | - | | - | | - | | | | |
| | redundancy. | | | | | | | | | |
| (U) | In FY 2005: Develop an integrate | - | | | | - | | | | |
| | between an airborne communicati | - | | | | - | | | | |
| | conditions. Develop subsystem te bandwidth communication needs. | • | - | • • | - | - | | | | |
| | Develop aircraft optical network t | | - | - | - | | 0 | | | |
| | frequency systems through a distri | | - | | - | | 0 | | | |
| (U) | Total Cost | | C | | · | • | | 4.511 | 6.018 | 9.519 |
| (U) | C. Other Program Funding Sur | nmary (\$ in Milli | ons) | | | | | | | |
| Ì, | | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | <u>FY 2008</u> | <u>FY 2</u> | <u>009</u> <u>Cost to</u> | T (10) |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estir | | <u>Total Cost</u> |
| (U) | PE 0602204F, Aerospace | | | | | | | | | |
| (0) | Sensors. | | | | | | | | | |
| | PE 0602500F, Malti Dissiplinery Space | | | | | | | | | |
| (0) | Multi-Disciplinary Space Technology. | | | | | | | | | |
| | PE 0603203F, Advanced | | | | | | | | | |
| (U) | Aerospace Sensors. | | | | | | | | | |
| (U) | PE 0603270F, Electronic | | | | | | | | | |
| | Combat Technology. | | | | | | | | | |
| (U) | This project has been | | | | | | | | | |
| | coordinated through the | | | | | | | | | |
| Pro | ject 5034 | | R | -1 Shopping List - I | tem No. 27-15 of 2 | 27-18 | | | Exhibit R-2a | (PE 0603500F) |

| | UNCLASSIFIED | |
|---|---|---|
| Exhibit R-2a, RDT&E Pr | oject Justification | DATE February 2004 |
| BUDGET ACTIVITY 33 Advanced Technology Development (ATD) | | T NUMBER AND TITLE dvanced Space Sensors |
| (U) C. Other Program Funding Summary (\$ in Millions) Reliance process to harmonize efforts and eliminate duplication. (U) D. Acquisition Strategy Not Applicable. | | |
| Project 5034 R-1 S | hopping List - Item No. 27-16 of 27-18 422 | Exhibit R-2a (PE 0603500) |

| Ex | hibit R-2a, I | RDT&E Pro | oject Justif | fication | | | DATE | February | 2004 |
|--|---|--|--|--|---|-----------------------------------|---|----------------------------|-------------------------|
| BUDGET ACTIVITY 03 Advanced Technology Development | (ATD) | | | PE NUMBER AND 0603500F MU DEV SPACE 1 | LTI-DISCIPLI | NARY ADV | PROJECT NUME 5062 Advanc Vehicles | | es for Space |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| 5062 Advanced Structures for Space Vehicles | Actual 2.415 | Estimate 2.975 | Estimate 0.000 | Estimate 0.000 | Estimate 2.906 | Estimate 0.870 | Estimate 0.460 | Complete Continuing | TBD |
| Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) <u>A. Mission Description and Budget Ite</u> This project identifies, develops, and den operability, responsiveness, and cost-effe controls. Technology demonstration incl | nonstrates the te ectiveness. Enal | oling technolog | gies include the | ermal protection | , structures, vel | hicle systems, | | | and |
| (U) B. Accomplishments/Planned Program (U) MAJOR THRUST: Develop the airframe (U) In FY 2003: Developed the airframe and space systems including the thermal protectechnologies that enable aerospace vehicle cost-effectiveness. Investigated integration these aerospace vehicle configurations such airbreathing-based hypersonic propulsion. (U) In FY 2004: Continue developing the airfraccess to space systems including the thermal cost-effectiveness. | and payload tec payload technol ction, structural es to exhibit reve on of the multidi ch as materials, n frame and payloa mal protection, | ogies required configuration olutionary capa sciplinary tech munitions, hum ad technologies structural, conf | to enable next , and vehicle an , bility, operabli nologies requinan effectivene s required to er figuration and | generation reus nd payload syste lity, responsiver red to design an ess, and both roc nable next gener vehicle and pay | able access to em ness, and d demonstrated ket- and ration reusable load system | _ | <u>7 2003</u> 2.415 | <u>FY 2004</u> 2.975 | <u>FY 2005</u> 0.000 |
| (U) In FY 2005: Not Applicable. Efforts in th(U) Total Cost | | e delayed unti | l FY 2007 due | to higher Air F | orce priorities. | | 2.415 | 2.975 | 0.000 |
| (U) <u>C. Other Program Funding Summary (</u> <u>FY</u> PE 0602500F, (U) Multi-Disciplinary Space Technology. | <u>Y 2003</u> F | | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | <u>FY 2008</u> <u>Estimate</u> | FY 2009 Estimate | <u>Cost to</u> Complete | <u>Total Cost</u> |
| Project 5062 | | R-1 Sh | opping List - Iten 42 | n No. 27-17 of 27- 3 | 18 | | | Exhibit R-2a | PE 0603500F) |

| Exhibit R-2a, RDT&E P | DATE | |
|--|--|---|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV | February 2004 PROJECT NUMBER AND TITLE 5062 Advanced Structures for Spac Vehicles |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. | | |
| (U) D. Acquisition Strategy Not Applicable. | | |
| Project 5062 R-1 S | hopping List - Item No. 27-18 of 27-18 | Exhibit R-2a (PE 0603500F |

PE NUMBER: 0603601F PE TITLE: Conventional Weapons Technology

| EXNI | bit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 |
|---|--|-----------------|----------------|-----------------|-----------------------|----------------|---------------|-----------------|----------------|
| BUDGET ACTIVITY 03 Advanced Technology Development | (ATD) | | | E NUMBER AND | TITLE ventional We | apons Techr | nology | lobraary | |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| Total Program Element (PE) Cost | 45.070 | 37.198 | 22.398 | 22.594 | 23.024 | 23.409 | 23.785 | Continuing | 0.00 |
| 670A Ordnance Technology | 21.079 | 21.463 | 13.826 | 13.937 | 14.193 | 14.430 | 14.663 | Continuing | 0.00 |
| 670BGuidance TechnologyNote:In FY 2004, the funding was reduced as | 23.991 | 15.735 | 8.572 | 8.657 | 8.831 | 8.979 | 9.122 | Continuing | 0.00 |
| U) <u>A. Mission Description and Budget Ite</u> This program develops, demonstrates, an projects: (1) development of conventiona including seekers, navigation and control | d integrates ordr ll ordnance techn l, and guidance. | ologies includi | ng warheads, f | uzes, and explo | osives; and (2) o | levelopment of | advanced guid | lance technolog | gies |
| Lock-On after Launch (LOAL) - Live Te U) B. Program Change Summary (\$ in M | • | | | | | | | | |
| | | | | | | FY 2003 | FY 2 | 2004 | <u>FY 2005</u> |
| U) Previous President's Budget | | | | | | 43.605 | 30 | .516 | 22.456 |
| U) Current PBR/President's Budget | | | | | | 45.070 | 37 | .198 | 22.398 |
| U) Total Adjustments | | | | | | 1.465 | 6 | .682 | |
| U) Congressional Program Reductions | | | | | | | | | |
| Congressional Rescissions | | | | | | | | .318 | |
| Congressional Increases | | | | | | 0.544 | 7 | .000 | |
| Reprogrammings | | | | | | 2.544 | | | |
| SBIR/STTR Transfer | | | | | | -1.079 | | | |
| $\mathbf{I} = \mathbf{I} = \mathbf{I} = \mathbf{I} = \mathbf{I}$ | | | | | | | | | |
| (U) <u>Significant Program Changes:</u> | | | | | | | | | |
| J) <u>Significant Program Changes:</u> Not Applicable. | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| | Ex | thibit R-2a, F | ject Justifi | ication | | | DATE | February | 2004 | |
|---|--|--|--|---|---|---|-----------------|-----------------------------|-----------------|--------------|
| | ET ACTIVITY dvanced Technology Development | (ATD) | | 0 | E NUMBER AND 603601F Con echnology | | eapons | PROJECT NUME 670A Ordnan | BER AND TITLE | ду |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ III MIIIIOIIS) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 670A | | 21.079 | 21.463 | 13.826 | 13.937 | 14.193 | 14.430 | 14.663 | Continuing | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 (U) 1 | A. Mission Description and Budget Ite This project develops, demonstrates, and conventional ordnance including warhea conventional ordnance supporting an Air B. Accomplishments/Planned Program MAJOR THRUST: Develop and demons technologies to improve munition effective improving sortie effectiveness and increase function data from penetrating weapons the In FY 2003: Supported the cooperative per target detection device, and a directional of Monolithic Integrated Circuit technologies rates up to 2,500 meters per second. Com- time-of-arrival attributes that can be used protective tunnel doors and destroy tunned in FY 2004: Complete cooperative progra target detection device, and a directional of the FY 2004: Complete cooperative progra target detection device, and a directional of the FY 2005: Continue design of a fuze us portex accuracy of 0.5 meter for weapons the next mark target influence fuze capable of deny | I integrates ordna ids, fuzes, explosi r Expeditionary F (\$ in Millions) strate advanced ai veness, allowing f sing strike aircraf hrough various have rogram with the b warhead package es that will give b npleted design tra to defeat hard an l contents with in am with the Unite warhead package give a burst accurate g a hard target inf | ves, carriage a force. r-delivered mut for smaller wan t load-outs. D and target medi United Kingdo Improved the urst accuracy of des for precision d deeply burie truding blast p ed Kingdom to Continue des acy of 0.5 meter luence fuze car Monolithic Inter- | and release, and initions fuze an iheads and mur evelop a fuzing ums. m to design an e design of a fu of 0.5 meters fo on-guided mun d targets that w ressures. o ground test an sign of a fuze u ers for weapons apable of denyin egrated Circuit 00 meters per so | I munition integ ad mass-focusir nition airframes g capability that integrated fuze ize using Micro or weapons that itions with prece- vill be used to o a integrated fuze sing Microwav s that have close ng hard and dec- | gration technolo og warhead , thereby c will transmit e, an improved wave have closure cise, verpower e, an improved e Monolithic ure rates up to eply buried at will give | ogies. This pro | - | | - |
| (U)] | MAJOR THRUST: Develop and demons technologies to include innovative air-del concepts, and reduced airframe size provi terospace vehicle and other multiple mini | ivered munition of ding the capability | carriage and re | lease equipmen ry, launch, and | nt, miniature we | eapon release with the | | 5.289 | 3.325 | 3.301 |
| Proje | ect 670A | | R-1 Sł | nopping List - Iter | m No. 28-2 of 28- | 7 | | | Exhibit R-2a (F | PE 0603601F) |
| | | | | 426 | 3 3 | | | | | |

| Exhibit R-2a, RDT&E Project Justification February 2004 | | | | | | | |
|--|--|---|----------------|-------------|--|--|--|
| BUDGET ACTIVITY 3 Advanced Technology Development (ATD) | | ECT NUMBER AND TITLE Ordnance Technology | | | | | |
| load-outs and improve sortie effectiveness for current and futu requirements. | re strike aircraft while reducing munition airlift | | | | | | |
| U) In FY 2003: Completed design of a low-cost, precision-guided and lethal effectiveness against 85% of the MK-83 and BLU-1 | | | | | | | |
| U) In FY 2004: Begin an effort to integrate components and techn biological warfare facilities. Begin an effort to develop a mult range of unhardened ground targets. | • | | | | | | |
| U) In FY 2005: Demonstrate a weapon that can neutralize chemic to develop a multi-mode ordnance package effective against a | - | | | | | | |
| U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and c technologies, including heavy metal liners, dense metal cases, release performance attributes. The goal of these efforts is to c protective surfaces and by enhancing kill mechanisms against million in FY 2003 Congressional Add funding for the BLU-1 | and insensitive explosives with increased energy destroy hardened targets by more effectively penetrating softer surface targets. Note: This effort includes \$3.0 | 9.075 | 10.818 | 5.175 | | | |
| U) In FY 2003: Improved the design and began fabrication of a v hard targets by integrating a new warhead case technology, ins preliminary design of a unitary warhead penetrator capable of storage facilities with minimum collateral damage. Investigate as nano-scale aluminum. Designed new warhead for the BLU | weapon capable of high-speed penetration of extremely sensitive explosive, and multiple-event fuze. Completed damaging weapons of mass destruction production and ed maturing designs of advanced reactive materials such | | | | | | |
| J) In FY 2004: Continue designing and fabricating a warhead ca deep targets by integrating a new warhead case technology, ins Demonstrate a Tantalum warhead to provide attack capability Systems. | pable of surviving high-speed penetration of extremely sensitive explosives, and a multiple-event fuze. | | | | | | |
| J) In FY 2005: Continue designing and fabricating a weapon cap targets by integrating new warhead case technology, insensitiv insensitive explosive warhead fills with a goal to significantly completing the intended ordnance mission. | ve explosive, and a multiple-event fuze. Improve | | | | | | |
| U) Total Cost | | 21.079 | 21.463 | 13.826 | | | |
| Project 670A | R-1 Shopping List - Item No. 28-3 of 28-7 | | Exhibit R-2a (| PE 06036011 | | | |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | I | DATE February | 2004 |
|-------------------|--|---------------------------------|-----------------------------------|-----------------------------------|---|-----------------------------------|---------------------|------------------------------|------------------|-------------------|
| | ET ACTIVITY dvanced Technology Develop | oment (ATD) | | | PE NUMBER AI 0603601F Co Technology | onventional W | Veapons | | NUMBER AND TITLE | |
| U) (| C. Other Program Funding Sum | <u>mary (\$ in Milli</u> | <u>ons)</u> | | | | | | | |
| U) I T U) I | Related Activities: PE 0602602F, Conventional Munitions. This project has been coordinated through the Reliance process to harmonize efforts and eliminate | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | FY 2008 Estimate | <u>FY 20</u> <u>Estim</u> | | <u>Total Cost</u> |
| (U) | duplication. <u>D. Acquisition Strategy</u> Not Applicable. | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Proje | ect 670A | | F | R-1 Shopping List | - Item No. 28-4 of 2 | 8-7 | | | Exhibit R-2a (| PE 0603601 |

| Exhibit R-2a, RDT&E Project Justification | | | | | | | | DATE | February | 2004 |
|---|---|--|--|---|---|---|----------------|------------------------|-------------------------|-------------------------|
| | UDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND TITLE 3 Advanced Technology Development (ATD) 0603601F Conventional Weapons 670B Guidance Technology Technology Technology 670B Guidance Technology | | | | | | | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 670B | | 23.991 | 15.735 | 8.572 | 8.657 | 8.831 | 8.979 | | Continuing | 0.000 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | A. Mission Description and Budget Iter This project develops, demonstrates, and from manned and unmanned aerospace v navigation sensors for standoff delivery v probability. | integrates afford ehicles. This pro- | oject includes o | levelopment of | f conventional v | weapon guidand | ce systems inc | luding terminal | seekers, midco | urse |
| (U) M r i (U) I (U) I (U) I (U) I | B. Accomplishments/Planned Program MAJOR THRUST: Develop and demonstructions applications. These seeker tech n adverse weather and battlefield condition ninimize collateral damage while providin n FY 2003: Investigated low-cost, laser re Agency-developed fixed, detector array te n FY 2004: Begin design of a low-cost, l noving parts of earlier generation laser see in FY 2005: Finalize design and begin fail data rate and reduce moving parts of earlier | trate advanced consolete advanced consolete will autors. Also, the send increased weared ar seeker tech chnology for por aser detection ar eker technologie brication of a low | tonomously de eker technolog upons load-out nologies, like I cential Air Forc id ranging seek s. v-cost, laser de | tect, acquire, a ies will increas and improved Defense Advan e applications. er that will inc tection and ran | nd guide to targ se the probabilit sortie effectiven aced Research P crease data rate | gets of interest ty of kill and ness. Projects and reduce | F | <u>Y 2003</u> 2.782 | <u>FY 2004</u> 2.417 | <u>FY 2005</u> 2.968 |
| t (U) I v t | MAJOR THRUST: Develop and demonst o increase armament navigation accuracy electronic jamming environments. n FY 2003: Completed developing interf weapon terminal guidance seeker. Design echnology to provide an accurate (less that han \$6,000 per unit) Global Positioning S | , improve stand face between a ta led a munition na an one meter), m | off range, and or rget detection avigation system iniature (less th | enhance weapo device, fuze, d m using micro- han 25 cubic ir | ons control and irectional warhe- electromechani aches), and affo | operation in ead, and ical system rdable (less | | 1.932 | 2.175 | 2.152 |
| a (U) I F | applications. In FY 2004: Continue developing a munit provide an accurate (less than one meter), unit) Global Positioning System/Inertial M | tion navigation s miniature (less t | ystem using m han 25 cubic ir | icro-electrome toches), and affe | chanical system | n technology to | | | | |
| Proje | ect 670B | | R-1 Sh | | m No. 28-5 of 28- | 7 | | | Exhibit R-2a (I | PE 0603601F) |
| | | | | 429 | 9 | | | | | |

| Exhibit R-2a, RDT&E Project Justification DATE February 2004 | | | | | | | |
|--|--|---|-----------------|--------------|--|--|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | | ECT NUMBER AND TITLE Guidance Technology | | | | | |
| (U) In FY 2005: Continue developing a munition navigation system using provide an accurate (less than one meter), miniature (less than 25 cubi unit) Global Positioning System/Inertial Measurement Unit navigation (U) | ic inches), and affordable (less than \$6,000 per | | | | | | |
| (U) MAJOR THRUST: Integrate advanced conventional guidance techno datalinks, and algorithms to provide improved adverse weather perform higher probability of target detection, an operationally acceptable targe effectiveness of miniature munitions against both mobile and fixed gro (U) In FY 2003: Investigated low-cost seeker, guidance hardware, and au | mance, faster processing of target information, get false alarm rate, and enhance the ound targets. atonomous target recognition software | 4.898 | 4.202 | 3.452 | | | |
| (U) In FY 2004: Design a data link for Low Cost Autonomous Attack Sysperform re-targeting, in-flight capability after munition has separated for Low Cost Autonomous Attack Sysperform re-targeting, in-flight capability after munition has separated for the LOC | stem (LOCAAS) to provide a capability to from launch aircraft. | | | | | | |
| (U) In FY 2005: Develop, fabricate, and flight test a datalink on the LOC. in-flight after munition has separated from launch aircraft. (U) | AAS providing the capability to re-target, | | | | | | |
| MAJOR THRUST/CONGRESSIONAL ADD: Develop technologies System (LOCAAS) program. Note: This effort includes Congression 2004 (\$1.0 million). | | 14.379 | 0.992 | 0.000 | | | |
| (U) In FY 2003: Enhanced the current LOCAAS Advanced Technology I completing more flight and ground testing. Additional LOCAAS ATI with a live warhead to demonstrate that the integrated technologies per Completing of the second se | D tasks included flight-testing of a LOCAAS or form as expected. | | | | | | |
| (U) In FY 2004: Complement the current LOCAAS development program and flight testing of a datalink on the weapon. (U) In FY 2005: Not Applicable. | n by accelerating the fabrication, integration, | | | | | | |
| (U) (U) CONGRESSIONAL ADD: Maverick Missile Upgrade Lock-On After (U) In FY 2003: Not Applicable. (U) In FX 2004. Conduct on operational utility evaluation of a Mayariak b | - | 0.000 | 5.949 | 0.000 | | | |
| (U) In FY 2004: Conduct an operational utility evaluation of a Maverick I subsystem. Test a Maverick missile with a data communication system launch. | | | | | | | |
| (U) In FY 2005: Not Applicable.(U) Total Cost | | 23.991 | 15.735 | 8.572 | | | |
| Project 670B R-1 | 1 Shopping List - Item No. 28-6 of 28-7 | | Exhibit R-2a (F | PE 0603601E) | | | |

| Exhibit R- | DATE February 2004 | |
|---|--|--------------------------|
| UDGET ACTIVITY 3 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603601F Conventional Weapons Technology | PROJECT NUMBER AND TITLE |
| U) <u>C. Other Program Funding Summary (\$ in Million</u> | ions) | |
| U) D. Acquisition Strategy Not Applicable. | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Project 670B | R-1 Shopping List - Item No. 28-7 of 28-7 | Exhibit R-2a (PE 060360 |

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PE NUMBER: 0603605F PE TITLE: Advanced Weapons Technology

| | Exhit | oit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 |
|------|--|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| | | | | | | TITLE | ons Technolo | ogy | | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| | Total Program Element (PE) Cost | 71.649 | 61.221 | 31.103 | 29.168 | 31.667 | 30.226 | 30.705 | Continuing | Continuing |
| 3150 | Advanced Optics Technology | 23.168 | 24.837 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | Continuing | Continuing |
| 3151 | High Power Solid State Laser Technology | 27.972 | 19.446 | 15.085 | 15.601 | 15.890 | 16.157 | 16.413 | Continuing | Continuing |
| 3152 | High Power Microwave Technology | 12.424 | 8.343 | 11.504 | 11.559 | 13.649 | 11.910 | 12.102 | Continuing | Continuing |
| 3647 | High Energy Laser Technology | 8.085 | 8.595 | 4.514 | 2.008 | 2.128 | 2.159 | 2.190 | Continuing | Continuing |

Note: In FY 2003, space unique tasks in Projects 3150 and 3647 were transferred to PE 0603500F in conjunction with the Space Commission recommendation to consolidate all space unique activities. In FY 2003, this program received \$10 million as part of the Iraqi Freedom Fund which is included in the above cost table.

(U) A. Mission Description and Budget Item Justification

This program provides for the development and demonstration of advanced directed energy and optical concepts that are not space unique. In solid state lasers, compact, reliable, relatively high power, cost-effective single devices and arrays of devices are demonstrated. In high power microwaves, technologies such as narrowband and wideband devices and antennas are demonstrated. In high energy lasers, technologies such as high power chemical lasers and beam control technologies are demonstrated. Note: In FY 2004, Congress added \$2.3 million for Geo Light Imaging National Testbed (GLINT), \$4.3 million for Mobile Active Targeting Resource for Integrated Experiments (MATRIX), \$1.0 million for Advanced Technology for Infrared Countermeasure Component Improvement, \$2.5 million for Aerospace Relay Mirror System Demonstration, \$8.5 million for Applications of LIDAR to Vehicles with Analysis, \$4.0 million for Laser Illuminated Viewing and Ranging Sensor Development, \$4.3 million for the Laser Spark Countermeasure Program, \$3.4 million for the Low Speed Air Data Sensor for Special Operations Aircraft, \$3.25 million for the Texas-New Mexico Sky Survey, and \$1.1 million for the Wafer Integrated Semiconductor Laser.

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

R-1 Shopping List - Item No. 29-2 of 29-19

| | Exhibit R-2, RDT&E Bu | DATE February 2004 | | |
|-----|---|---|----------------|----------------|
| | GET ACTIVITY Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603605F Advanced Weapons Technology | | - |
| (U) | B. Program Change Summary (\$ in Millions) | | | |
| | | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| (U) | Previous President's Budget | 53.381 | 27.024 | 30.229 |
| U) | Current PBR/President's Budget | 71.649 | 61.221 | 31.103 |
| U) | Total Adjustments | 18.268 | 34.197 | |
| U) | Congressional Program Reductions | | -0.127 | |
| | Congressional Rescissions | | -0.526 | |
| | Congressional Increases | | 34.850 | |
| | Reprogrammings | 18.977 | | |
| | SBIR/STTR Transfer | -0.709 | | |
| U) | Significant Program Changes: | | | |
| | Not Applicable. | | | |

R-1 Shopping List - Item No. 29-3 of 29-19

| | Ex | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DA | TE February | 2004 |
|---|---|---|--|--|---|--|----------|--------------------------------------|---------------------------------------|---------------------------------|
| BUDGET ACTIVITY 03 Advanced Te | chnology Development | (ATD) | | Q | PE NUMBER AND 1603605F Adv Fechnology | | ons | | UMBER AND TITLE anced Optics Te | chnology |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ III MIIIIOIIS) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | ` | |
| | d Optics Technology | 23.168 | 24.837 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 00 Continuing | Continuing |
| | of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | |
| unique activities. (U) <u>A. Mission</u> This project (U) <u>B. Accomplis</u> (U) MAJOR THF (U) In FY 2003: | , space unique tasks in Project Description and Budget Ite develops advanced optical to shments/Planned Program RUST: Civilian salaries. This project previously inclu- inary Space Technology. The Not Applicable | em Justification echnologies for v (\$ in Millions) uded space uniqu | various strategi e funding that | c and tactical b has been transf | beam control ap | plications. 03500F, | | nmendation <u>7 2003</u> 0.255 | <u>FY 2004</u> 0.000 | pace <u>FY 2005</u> 0.000 |
| (U) In FY 2005: (U) (U) CONGRESS (U) In FY 2003: Electro-Optic | Not Applicable. IONAL ADD: Applications Explored the utility of an op al System for deep space me | erational Field L etric and space of | aser Demonstr | ator laser radar tion missions, 1 | microsatellite tr | acking, and | | 11.379 | 8.287 | 0.000 |
| provide detail such as battle (U) In FY 2004: metric and sp Investigate no to provide a r Investigate ey combat identi | ile defense discrimination. I led information on satellites. damage assessment and can Demonstrate tracking ability ace object identification mis ovel concepts for using laser ange of battlefield informati- ve-safe laser radars and airbo- ification, battle damage asses | Investigated us nouflage penetra using the Field sions, microsatel radars to provide on such as battle orne demonstration | ing laser radars tion. Laser Demonst llite tracking, a e detailed infor damage assess ons of laser sen | to provide a rate trator's Hi-Class and ballistic mis mation on sate ment and came sing to battlefi | ange of battlefie ss laser radar for ssile defense dis llites. Investiga ouflage penetrat | eld information r deep space scrimination. te laser radars tion. | | | | |
| | Not Applicable. IONAL ADD: Laser Illumin Developed and demonstrated | - | | - | | thering | | 4.155 | 4.000 | 0.000 |
| Project 3150 | - | - | • | | n No. 29-4 of 29-1 | • | | | Exhibit R-2a (| PE 0603605F) |
| | | | | 435 | | | | | · · · · · · · · · · · · · · · · · · · | · · · · · |

| Exhibit R-2a, RDT&E I | DA | DATE February 2004 | | |
|--|---|---|-----------------|--------------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | | JECT NUMBER AND TITLE O Advanced Optics Technology | | |
| battlefield images. Developed advanced sensor technology for eye-sa electron bombarded charged coupled devices cameras and laser imag (U) In FY 2004: Develop and demonstrate eye-safe laser sensing technol as target imagery, target identification, and battle damage assessment bombarded active pixel sensor mated with an advanced imaging chip Illuminated Viewing and Ranging Sensor subsystem (sensor and opti ball turret imaging system. | ing beam control assemblies. logies for obtaining battlefield intelligence such t. Complete development of a gated electron c. Complete design and delivery of a Laser | | | |
| (U) In FY 2005: Not Applicable. | | | | |
| (U) (U) CONGRESSIONAL ADD: Geosynchronous Light Imaging Nationa (U) In FY 2003: Continued development and integration of hardware for (GLINT) at White Sands Missile Range, New Mexico. Built one held | the Geo Light Imaging National Testbed | 2.333 | 2.500 | 0.000 |
| Performed field experiment to collect light from stars.(U) In FY 2004: Evaluate and demonstrate concepts and components for development and integration of hardware. Build one heliostat demon field experiment to test hardware performance and demonstrate imag | stration unit and one mini-receiver. Perform a | | | |
| (U) In FY 2005: Not Applicable.(U) | ing concept under controlled conditions. | | | |
| (U) CONGRESSIONAL ADD: Mobile Active Tracking Resource for In (U) In FY 2003: Developed a first generation testbed for assessment of f sensors. Evaluated tracking, discrimination, and targeting algorithms surveillance/situational awareness missions. | uture tactical laser beam control/fire control | 5.046 | 4.300 | 0.000 |
| (U) In FY 2004: Develop/enhance ground-based and airborne beam cont various active and passive sensors for high energy laser beam control enhancements for the Advanced Tactical Laser, but also support risk weapons. Perform ground testing in New Mexico and Hawaii. | . Concentrate on beam control and fire control | | | |
| (U) In FY 2005: Not Applicable.(U) | | | | |
| (U) CONGRESSIONAL ADD: Aerospace Relay Mirror System Demon (U) In FY 2003: Not Applicable. Added to PE 0603500F, Multi-Discipl Technology, in FY 2003. | | 0.000 | 2.500 | 0.000 |
| (U) In FY 2004: Acquire initial components and software build to invest extend the range of various optical systems including high energy las a laboratory demonstration that will verify scaleable system performance. | er weapons. Test and integrate components into | | | |
| | 1 Shopping List - Item No. 29-5 of 29-19 | | Exhibit R-2a (F | PE 0603605F) |

| | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
|---|--|------------------------------|----------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|----------------------------|-------------------|
| | | | | | | | CT NUMBER AND TITLE Advanced Optics Technology | | |
| identify potential field demon and high energy optics will be (U) In FY 2005: Not Applicable. (U) (U) CONGRESSIONAL ADD: 7 (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop technol | e researched for future Texas-New Mexico Sk | testbed upgrade y Survey. | s. | | | es | 0.000 | 3.250 | 0.000 |
| Redesign of the prime focus c search telescope.(U) In FY 2005: Not Applicable.(U) Total Cost | orrector of the Hobby- | Eberly Telescop | pe. Complete th | e optical design | for a wide-field | | 23.168 | 24.837 | 0.000 |
| (U) <u>C. Other Program Funding</u> (U) Related Activities: | Summary (\$ in Milli FY 2003 Actual | ons) FY 2004 Estimate | <u>FY 2005</u> Estimate | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> Complete | <u>Total Cost</u> |
| PE 0603444F, Maui Space Surveillance Systems. PE 0602102F, Materials. | | | | | | | | | |
| PE 0602605F, Directed Energy Technology. PE 0603883C, Ballistic Missi Defense Boost Phase Segment | le | | | | | | | | |
| PE 0602500F,(U) Multi-Disciplinary Space Technology. | | | | | | | | | |
| (U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology. | | | | | | | | | |
| (U) This project has been coordinated through the Reliance process to harmoniz efforts and eliminate | e | | | | | | | | |
| Project 3150 | | R | | Item No. 29-6 of 2 437 | 9-19 | | | Exhibit R-2a (| (PE 0603605F) |

| Exhibit R-2a, | DATE February 2004 | |
|--|--|--------------------------|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603605F Advanced Weapons Technology | PROJECT NUMBER AND TITLE |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> duplication. | | |
| (U) D. Acquisition Strategy Not Applicable. | | |
| | | |
| Project 3150 | R-1 Shopping List - Item No. 29-7 of 29-19 | Exhibit R-2a (PE 0603605 |

| | Ex | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 | |
|-------------|--|--|---|---|---|---|--|---|---|---------------------------------------|--|
| | GET ACTIVITY dvanced Technology Development | (ATD) | | Q | PE NUMBER AND 0603605F Adv Fechnology | | ons | PROJECT NUMBER AND TITLE 3151 High Power Solid State Laser Technology | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | |
| 315 | Technology | 27.972 | 19.446 | 15.085 | 15.601 | 15.890 | 16.157 | 16.413 | Continuing | Continuing | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| | reliable infrared sources that can be used systems. Longer-term goals focus on pro- self-protection. This project leads the de- used due to their low-cost, small size and features while continually scaling output areas. The first area investigates methods second area develops wavelength specifie | oducing compact velopment of, ar weight, high rel to higher power s to develop low | , significantly ad builds upon, liability, and hi s and efficienc -cost, scalable | higher power s a wide range of gh efficiency i ies and to milit high power so | ources that cou of commercial a n converting ele- ary application- olid state lasers. | ld be applied to advancements. ectricity to lase -specific wavel This effort bu | o military weap Commercially r energy. This engths. This p ilds upon a str | oons-type applic v available solid s project preserv project is divide | ations includin state lasers are es these attract l into two techn | g aircraft widely ive nology | |
| (U) | B. Accomplishments/Planned Program MAJOR THRUST: Demonstrate scalabili applications such as unmanned aerial vehi applications such as advanced gunship we In FY 2003: Participated in the Joint High | ity of high powe cle target design apons and airbo | ators/imagers a me laser illumi | and next genera nators. | ation weapons/o | components for | | <u>7 2003</u> 4.759 | <u>FY 2004</u> 7.076 | <u>FY 2005</u> 8.477 | |
| (U) | approaches for future directed energy, wea kilowatts, with scalability to 100 kilowatts Army, Air Force, High Energy Laser Joint In FY 2004: As part of the Joint High Pov approach. Begin design for 25 kilowatt de volume. | apons-class elect . Various appro . Technology Of wer Solid State L | ric laser techno aches selected fice. .aser program, | blogy at power for developme demonstrate 10 | levels greater t ent and demonst 0 kilowatts usin | han 10 tration by the | | | | | |
| (U) | In FY 2005: As part of the Joint High Pow approach that has scalability to 100 kilowa systems-level issues such as power and the will be evaluated between the various appr Technology Office. | atts. Address systemat manageme | stems-level iss ent requiremen | ues such as we ts. Factors suc | ight and volume | e. Investigate ce, cost, etc. | | | | | |
| (U) Proi | ect 3151 | | R-1 Sh | opping List - Iten | n No. 29-8 of 29-1 | 9 | | | Exhibit R-2a (| PE 0603605F) | |

| Exhibit R-2a, RDT&E Project Justification | DA | TE February | 2004 |
|--|--------|-----------------------------------|---------------|
| BET ACTIVITY PE NUMBER AND TITLE dvanced Technology Development (ATD) 0603605F Advanced Weapons Technology | | IMBER AND TITLE Power Solid St | |
| MAJOR THRUST: Develop and demonstrate high energy laser technologies for airborne tactical applications, including air-to-air and surface-to-air scenarios. Detect and track tactical targets in clutter at long ranges. In FY 2003: Addressed technologies including lasers for long-range detection of targets in clutter; high power compact laser scalability; and advanced beam control to compensate for platform vibration, atmospheric jitter, and aero-optic effects. Conducted laser effects testing and completed first phase of the development of a multi-kilowatt solid state laser testbed to determine required energy levels, propagation effects, and beam control requirements for tactical applications such as defeating next generation air-to-air threats. In FY 2004: Investigate technologies such as lasers for long-range detection of targets in clutter; high power compact lasers; and advanced beam control to compensate for platform vibration, atmospheric jitter, and aero-optic effects. | 0.528 | 3.613 | 6.608 |
| Complete laser effects testing using surrogate laser sources. Complete development and begin installation of a multi-kilowatt solid state laser testbed to confirm previous test results at system power levels and wavelengths. In FY 2005: Detect and track tactical targets in clutter at long ranges. Demonstrate scalable high-power compact lasers and advanced beam control to control platform vibration, atmospheric jitter, and aero-optic effects. Complete laser effects testing using a multi-kilowatt laser to determine required energy levels for tactical applications that address defeating next generation air-to-air threats. | | | |
| MAJOR THRUST: Develop and demonstrate laser source technologies needed to counter current air-to-air and surface-to-air missile threats. In FY 2003: Demonstrated a reliable and compact multispectral (bands I, II, and IV), solid state laser for countering current generation threats to aircraft platforms. | 3.351 | 3.257 | 0.000 |
| In FY 2004: Complete demonstration of a low-cost, reliable, and compact multispectral (bands I, II, and IV), solid state laser brassboard for future integration into large aircraft platforms. In FY 2005: Not Applicable. | | | |
| MAJOR THRUST: Develop solid state laser technologies that support enhancing the Battlefield Air Operations kit performance and reducing the weight by replacing separate and independent systems now fielded and incorporating the capabilities into a single unit. Part of this effort was funded from the Iraqi Freedom Fund. | 19.334 | 0.000 | 0.000 |
| In FY 2003: Developed solid state laser technologies to support Battlefield Air Operations applications such as target ranging, target designation, and wind measurement. Undertook overall systems integration of the laser components (wind sensor, rangefinder, designator, visible and infrared aim lights) with other modules (optics, geo-location, processor/electronics, power, etc.) In FY 2004: Not Applicable. In FY 2005: Not Applicable. | | | |
| ect 3151 R-1 Shopping List - Item No. 29-9 of 29-19 | | Exhibit R-2a | (PE 0603605F) |

| Evhibit D.20 DDTOE Droi | ot luctification | | | DATE | | | |
|---|--|--------------------|-----------------|-----------------|--|-------------------|--|
| Exhibit R-2a, RDT&E Proje | | | | | February | 2004 | |
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER / 0603605F / Technolog | Advanced Weap | ons | | T NUMBER AND TITLE igh Power Solid State Laser blogy | | |
| (U) CONGRESSIONAL ADD: Low Speed Air Data Sensor for Special Operat | tions Aircraft. | | | 0.000 | 3.400 | 0.000 | |
| (U) In FY 2003: Not Applicable. | | | | | | | |
| (U) In FY 2004: Develop fiber optic laser-based data technology that will prov | | tions down to zero | 1 | | | | |
| knots for all fixed wing and rotary aircraft to increase safety operating in an | nd out of landing zones. | | | | | | |
| (U) In FY 2005: Not Applicable. | | | | | | | |
| (U) (U) CONCRESSIONAL ADD: Advanced Technology for Infrared Countering | Component Imag | overent | | 0.000 | 1.000 | 0.000 | |
| (U) CONGRESSIONAL ADD: Advanced Technology for Infrared Counterme(U) In FY 2003: Not Applicable. | asures Component Impr | ovement. | | 0.000 | 1.000 | 0.000 | |
| (U) In FY 2003: Not Applicable.(U) In FY 2004: Accelerate the potential deployment of the previously develop | ed mid-infrared semicor | nductor laser | | | | | |
| brassboard for infrared countermeasures applications. Initiate a risk reducti | | | | | | | |
| survivability issues for the laser transmitter. Demonstrate that a mid-infrare | - | | | | | | |
| survive operational military random vibration and temperature environment | ts. A series of rapid desi | gn/test iterations | | | | | |
| shall be conducted on the sub-scale demonstration unit in order to isolate th | e environmental impact | on key | | | | | |
| subassemblies in the design such as the cryogenic cooling subassembly. | | | | | | | |
| (U) In FY 2005: Not Applicable. | | | | | | | |
| (U) (U) CONCRESSIONAL ADD: Wafer Integrated Semiger ductor Legar | | | | 0.000 | 1.100 | 0.000 | |
| (U) CONGRESSIONAL ADD: Wafer Integrated Semiconductor Laser.(U) In FY 2003: Not Applicable. | | | | 0.000 | 1.100 | 0.000 | |
| (U) In FY 2004: Improve the reliability and lower the cost of high power laser | diode arrays. Develop t | he technology for | | | | | |
| integrating turning mirrors and micro-lenses onto a laser chip, thus implement | | | | | | | |
| the semiconductor manufacturing process. | - | - | | | | | |
| (U) In FY 2005: Not Applicable. | | | | | | | |
| (U) | | | | | | | |
| (U) Total Cost | | | | 27.972 | 19.446 | 15.085 | |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | | | | | | |
| <u>FY 2003</u> <u>FY 2004</u> <u>FY</u> | <u>2005</u> <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> | Cost to | Total Cost | |
| | timate <u>Estimate</u> | Estimate | <u>Estimate</u> | <u>Estimate</u> | <u>Complete</u> | <u>10tul Cost</u> | |
| (U) Related Activities: | | | | | | | |
| (U) PE 0602102F, Materials. PE 0603270F, Electronic | | | | | | | |
| (U) Combat Technology. | | | | | | | |
| PE 0602605E Directed Energy | | | | | | | |
| (U) Technology. | | | | | | | |
| Project 3151 R-1 Shopp | bing List - Item No. 29-10 of | 29-19 | | | Exhibit R-2a | (PE 0603605F) | |
| | 441 | 20 10 | | | ZAMOR IV Za | | |

| Exhibit R-2a, RDT&E Pr | roject Justification | | DATE February 2004 | |
|--|--|--|---------------------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603605F Advanced Weapons Technology | PROJECT NUMBER AND TITLE 3151 High Power Solid State La Technology | | |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. | | | | |
| (U) D. Acquisition Strategy Not Applicable. | | | | |
| Project 3151 R-1 S | hopping List - Item No. 29-11 of 29-19 442 | | Exhibit R-2a (PE 0603605F | |

| Technology Technology Cost (\$ in Millions) FY 2003 FY 2004 FY 2005 FY 2007 FY 2008 FY 2009 Cost to Comple 3152 High Power Microwave Technology 12.424 8.343 11.504 11.559 13.649 11.910 12.102 Contin Quantity of RDT&E Articles 0 < | | | | | | | | | | February | 2004 |
|---|--|--|--|---|--|---|--|---|--|--|---|
| Cost (\$ in Millions) Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete 3152 High Power Microwave Technology 12.424 8.343 11.504 11.559 13.649 11.910 12.102 Continu Quantity of RDT&E Articles 0< | | | C | 0603605F Advanced Weapons 315 | | | 3152 High Po | 152 High Power Microwave | | | |
| Actual Estimate Estimate <thestimate< th=""> Estimate <t< th=""><th>Cost (\$ in Mill</th><th>ions) FY:</th><th>Y 2003</th><th>FY 2004</th><th></th><th>FY 2006</th><th>FY 2007</th><th>FY 2008</th><th>FY 2009</th><th>Cost to</th><th>Total</th></t<></thestimate<> | Cost (\$ in Mill | ions) FY: | Y 2003 | FY 2004 | | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| Quantity of RDT&E Articles 0 </th <th></th> <th>Ac</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>Complete</th> <th></th> | | Ac | | | | | | | | Complete | |
| (U) <u>A. Mission Description and Budget Item Justification</u> This project develops high power microwave (HPM) generation and transmission technologies that support a wide range of Air Force missions such as the pp disruption, degradation, damage, or destruction of an adversary's electronic infrastructure and military capability. These targeted capabilities include local cc communication systems, as well as large and small air defense and command and control systems. In many cases, this effect can be generated covertly with 1 structural or human damage. In addition, millimeter wave force protection technologies are developed. It also develops a susceptibility/vulnerability/ethalii identify potential vulnerabilities of U.S. systems to HPM threats and to provide a basis for future offensive and defensive weapon system decisions. Represe and foreign assets are tested to understand real system susceptibilities. Both wideband (wide frequency range) and narrowband (very small frequency range) are being developed. (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> <u>FY 2003</u> <u>FY 2004</u> (U) MAJOR THRUST: Develop and demonstrate HPM technologies to disrupt, degrade, damage, or destroy an 4.724 3.465 adversary's electronic systems. (U) In FY 2003: Completed a repetitively pulsed gigawatt-class HPM experiment. Conducted wideband field experiments with integrated compact devices to demonstrate effectiveness of wideband HPM for munitions and airborne electronic attack. Conducted initial ground-based, field experiments to demonstrate effectiveness of air-delivered HPM munitions. (U) In FY 2004: Demonstrate an integrated repetitively pulsed gigawatt-class HPM breadboard. Conduct wideband field experiments with integrated compact devices to demonstrate effectiveness of wideband HPM for munitions and airborne electronic attack. Conduct an integrated wideband concealed weapon identification experiment. (U) In FY 2005: Demonstrate an integrated wideband concealed weapon ident | | | | | | | | | | Continuing | Continuing |
| This project develops high power microwave (HPM) generation and transmission technologies that support a wide range of Air Force missions such as the podisruption, degradation, damage, or destruction of an adversary's electronic infrastructure and military capability. These targeted capabilities include local cocommunication systems, as well as large and small air defense and command and control systems. In many cases, this effect can be generated covertly with a structural or human damage. In addition, millimeter wave force protection technologies are developed. It also develops a susceptibility/vulnerability/lethalii identify potential vulnerabilities of U.S. systems to HPM threats and to provide a basis for future offensive and defensive weapon system decisions. Represe and foreign assets are tested to understand real system susceptibilities. Both wideband (wide frequency range) and narrowband (very small frequency range) are being developed. (U) B. Accomplishments/Planned Program (\$ in Millions) (U) B. Accomplishments/Planned Program (\$ in Millions) (U) MAJOR THRUST: Develop and demonstrate HPM technologies to disrupt, degrade, damage, or destroy an adversary's electronic systems. (U) In FY 2003: Completed a repetitively pulsed gigawatt-class HPM experiment. Conducted wideband field experiments with integrated compact devices to demonstrate effectiveness of wideband HPM for munitions and airborne electronic attack. Conducted initial ground-based, field experiments of wideband HPM for munitions and airborne electronic attack. Conduct additional ground-based, field experiments demonstrate generated every for a air-delivered HPM munitions. (U) In FY 2005: Demonstrate an integrated repetitively pulsed gigawatt-class HPM breadboard. Conduct wideband field experiments with integrated compact devices to demonstrate effectiveness of air-delivered HPM munitions. (U) In FY 2005: Demonstrate an integrated repetitively based giga | Quantity of RDT&E Art | ticles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (U) MAJOR THRUST: Develop and demonstrate HPM technologies to disrupt, degrade, damage, or destroy an 4.724 3.465 adversary's electronic systems. (U) In FY 2003: Completed a repetitively pulsed gigawatt-class HPM experiment. Conducted wideband field experiments with integrated compact devices to demonstrate effectiveness of wideband HPM for munitions and airborne electronic attack. Conducted initial ground-based, field experiment to demonstrate effectiveness of air-delivered HPM munitions. (U) In FY 2004: Demonstrate an integrated repetitively pulsed gigawatt-class HPM breadboard. Conduct wideband field experiments with integrated compact devices to demonstrate effectiveness of wideband HPM for munitions and airborne electronic attack. Conduct additional ground-based, field experiments demonstrating effectiveness of air-delivered HPM munitions. Conduct an integrated wideband concealed weapon identification experiment. (U) In FY 2005: Demonstrate pulsed power and narrowband HPM source capability applicable to munitions and airborne concepts. Demonstrate a repetitively pulsed multi-gigawatt-class HPM integration experiment. Demonstrate | This project develops high p disruption, degradation, dar communication systems, as structural or human damage identify potential vulnerabil and foreign assets are tested | power microwave (H) mage, or destruction of well as large and sma e. In addition, millime lities of U.S. systems | HPM) gene n of an adve mall air def meter wave ns to HPM | ersary's electro fense and comme force protection threats and to p | nic infrastruct mand and cont on technologie provide a basis | ure and military rol systems. In es are developed s for future offer | capability. The many cases, the data of the many cases, the data of the many cases and deversive and defersive and deferses and deferse | nese targeted ca is effect can be lops a suscepti nsive weapon s | apabilities inclu e generated cov ibility/vulnerabi system decision | ide local computertly with no co ility/lethality da s. Representativ | ter and bllateral ta base to ve U.S. |
| concepts. Demonstrate a repetitively pulsed multi-gigawatt-class HPM integration experiment. Demonstrate | U) MAJOR THRUST: Develop adversary's electronic system U) In FY 2003: Completed a re experiments with integrated airborne electronic attack. C air-delivered HPM munition U) In FY 2004: Demonstrate ar experiments with integrated airborne electronic attack. C air-delivered HPM munition | p and demonstrate HP ns. epetitively pulsed giga compact devices to de Conducted initial grou s. n integrated repetitive compact devices to de Conduct additional gro s. Conduct an integra | HPM techno gawatt-clas demonstra bund-based vely pulsed demonstra ground-base grated wide | ss HPM experi te effectivenes , field experim l gigawatt-class te effectivenes ed, field experi band conceale | ment. Conduc s of wideband ent to demons s HPM breadb s of wideband ments demons d weapon iden | cted wideband fi HPM for munit trate effectivene oard. Conduct HPM for munit strating effective tification experi | ield tions and ess of wideband field tions and eness of iment. | | | | <u>FY 2005</u> 1.324 |
| brassboard wideband concealed weapon identification concept. (U) (U) MAJOR THRUST: Conduct effects experimentation to expand and refine data library and support susceptibility predictions. (U) In FY 2003: Applied computer codes to predict HPM coupling to targets and validate code prediction accuracy. Investigated and developed models to quantify the effectiveness of HPM waveforms against electronic targets of interest applicable to munitions or airborne platforms. Refined the ability to calculate probability of kill for | concepts. Demonstrate a rep brassboard wideband concea U) U) MAJOR THRUST: Conduc predictions. U) In FY 2003: Applied compu Investigated and developed r | betitively pulsed multi aled weapon identificant t effects experimentat atter codes to predict H models to quantify the | ilti-gigawat ication cond tation to ex t HPM coup the effective | tt-class HPM in cept. pand and refin pling to targets eness of HPM | e data library and validate o waveforms ag | eriment. Demoi and support susc code prediction a ainst electronic | nstrate ceptibility accuracy. targets of | | 2.270 | 1.361 | 0.782 |
| Project 3152 R-1 Shopping List - Item No. 29-12 of 29-19 Exhibit R | Project 3152 | | | R-1 Sho | pping List - Item | No. 29-12 of 29- | 19 | | | Exhibit R-2a (I | PE 0603605F) |

| | Exhibit R-2a, RDT&E Project | Justification | DA | February | 2004 |
|-----|--|--|-------|---------------------------------|--------------|
| | GET ACTIVITY Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603605F Advanced Weapons Technology | | MBER AND TITLE Power Microwa | |
| | representative targets. In FY 2004: Predict HPM coupling to targets with enhanced computer codes a Further refine models to quantify the effectiveness of HPM waveforms against to munitions or airborne applications. Enhance the ability to calculate probabil targets. In FY 2005: Provide dynamic data library to users and continue effects experim | electronic targets of interest applicable ity of kill for additional representative | | | |
| | data library. Transition computer codes for the prediction of electromagnetic c the evaluation and quantification of HPM waveform effectiveness against new interest. Transition computer codes for calculation of probability-of-kill for rep | oupling on targets to users. Expand and evolving electronic targets of | | | |
| (U) | | C | | | |
| (U) | MAJOR THRUST: Develop and evaluate active denial technologies for non-leapplications such as ground force protection from a standoff aircraft. | ethal, anti-personnel weapon | 1.967 | 2.649 | 4.650 |
| (U) | In FY 2003: Investigated the engineering design of next-generation millimeter denial technology. Perform computational physics simulations to analyze capa design before construction. Analyzed critical technologies for airborne active of computational simulation. | bility to validate airborne source | | | |
| (U) | * | velopment of millimeter wave source ecific computational physics al system specific computational ual design study for mobile n. Update subsystem approaches based | | | |
| (U) | In FY 2005: Provide user support operation/testing/demonstration of first grou Develop and evaluate technologies for non-lethal weapons applications. Contin wave source for airborne applications. Baseline computational physics simulat against the draft detailed design drawings. Investigate updated subsystem appr technical feasibility study. Provide technical expertise and background to exten Denial concepts and capabilities to their needs. | nue the development of millimeter ions of millimeter-wave sources oaches based on the original airborne | | | |
| (U) | | | | | |
| (U) | MAJOR THRUST: Develop the technology to integrate HPM devices on aeria target sets of interest. | l platforms and investigate specific | 3.463 | 0.868 | 4.748 |
| (U) | In FY 2003: Conducted target identification efforts to include individual target | s, groups, and clusters. Conducted | | | |
| Pro | ject 3152 R-1 Shopping | List - Item No. 29-13 of 29-19 | | Exhibit R-2a (F | PE 0603605F) |

| | | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | DATE | | 2004 | |
|------------|--|--|--|---|--|---|-----------------------------------|-----------------------------------|---|-------------------|--|
| | GET ACTIVITY Advanced Technology Developr | | | | PE NUMBER A | dvanced Wea | pons | | February 2004 CT NUMBER AND TITLE High Power Microwave hology | | |
| | experiments with an HPM source w Installed and used a trans/twist refle Performed integration tests on existi Obtained hardware and software intr aircraft. Started integration, therma In FY 2004: Continue airborne elect and/or cluster of targets. Conduct at chamber and the upgraded smaller at (e.g., electrical, interface, and therm HPM source on an aircraft. Begin in identify targets of interest and perfo In FY 2005: Proceed with target ide cluster targets. Perform target lethal aircraft integration issues such as ele interference/electromagnetic compa | ctor antenna on ng aircraft to de erface specificat l control, and tar tronic attack spe dditional HPM e nechoic chambe al control). Def nvestigating the rm battle damag entification effor ity assessments. | the existing anea fine the vehicle ions for several get studies for s ecific target iden experiments in the r. Begin investive ine aircraft alter feasibility of usive e assessment. tts to include for Maintain and use, thermal control | choic chamber f integration envi aircraft in order uch concepts. atification efforts the transverse ele agation of source ations and source ations and source ing a wideband l reign and domest pgrade the test f ol, (center of) m | or smaller exper- ronment for an H to integrate source for individual t ctromagnetic cell to aircraft integ e shielding requ HPM source to g cic and individua facilities. Invest ass, antennas, ele | iments. HPM device. rces on the argets and group Il anechoic gration issues ired to mount and geolocate and al, group and igate source to ectromagnetic |) | | | | |
| (U) | source on an aircraft. Investigate the interest and perform battle damage a Total Cost | • | sing ultra-wideł | oand HPM to get | plocate and iden | tify targets of | | 12.424 | 8.343 | 11.504 | |
| (U) | C. Other Program Funding Summ | nary (\$ in Milli | ons) | | | | | | | | |
| (U) (U) | Related Activities: PE 0602202F, Human Systems Technology. PE 0602605F, Directed Energy Technology. PE 0603851M, Nonlethal Weapons - Demonstration/Validation. This project has been coordinated through the Reliance process to harmonize efforts and eliminate | FY 2003 Actual | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | <u>FY 2006</u> <u>Estimate</u> | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> | |
| Pro | ject 3152 | | R | -1 Shopping List - | tem No. 29-14 of 2 445 | 29-19 | | | Exhibit R-2a (I | PE 0603605F) | |

| Exhibit R-2a, RDT& | E Project Justification | DATE February 2004 |
|--|--|---|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603605F Advanced Weapons Technology | PROJECT NUMBER AND TITLE 3152 High Power Microwave Technology |
| U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | |
| duplication. | | |
| (U) <u>D. Acquisition Strategy</u> Not Applicable. | | |
| | | |
| | | |
| | | |
| Project 3152 | R-1 Shopping List - Item No. 29-15 of 29-19 | Exhibit R-2a (PE 06036 |

| Exh | ibit R-2a, F | RDT&E Pro | - | | | | DATE | February | 2004 | |
|--|---|----------------------------------|---|---|---------------------------------------|----------|------------------------|---|-------------------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (/ | ATD) | | C | | | | | ROJECT NUMBER AND TITLE 647 High Energy Laser Technology | | |
| Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | |
| 3647 High Energy Laser Technology | 8.085 | 8.595 0 | 4.514 | | 2.128 | 2.159 | | Continuing | Continuing | |
| Quantity of RDT&E Articles0000000Note: In FY 2003, space unique tasks in Project 3647 were transferred to PE 0603500F in conjunction with the Space Commission recommendation to consolidate all space | | | | | | | | | D 2CA | |
| (U) <u>A. Mission Description and Budget Item</u> | | | | Siguretion with | | | | | pace | |
| (D) A. Mission Description and Budget item Justification This project provides for the development, demonstration, and detailed assessment of non-space unique technologies needed for high energy laser weapons. Near-term focus is on airborne high energy laser missions, although the technology developed for this project is directly applicable to most high energy laser applications. Critical technologies developed and demonstrated include advanced high energy laser devices and laser beam control to efficiently compensate and propagate laser radiation through the atmosphere to a target. Correcting the laser beam for distortions induced by propagation through the turbulent atmosphere is the key technology in most high energy laser applications. Detailed computational models to establish high energy laser weapon effectiveness and target vulnerability are developed. | | | | | | | | | | |
| (U) <u>B. Accomplishments/Planned Program (S</u> (U) MAJOR THRUST: Civilian salaries. (U) In FY 3003: This project previously includ Multi-disciplinary Space Advanced Develo that were inadvertently left behind. (U) In FY 2004: Not Applicable. (U) In FY 2005: Not Applicable. | ed space uniqu | | | | | | <u>7 2003</u> 1.192 | <u>FY 2004</u> 0.000 | <u>FY 2005</u> 0.000 | |
| (U) (U) MAJOR THRUST: Develop and demonstreefficiency for insertion in tactical airborne l (U) In FY 2003: Evaluated, demonstrated, and modeling and simulation and laboratory noz components. | asers and other enhanced mult | potential wear potential wear | oon application ure ejector noz | ns. zzles performanc | e using | | 0.781 | 2.257 | 2.585 | |
| (U) In FY 2004: Demonstrate optimized high p Demonstrate advanced iodine generation, io utilizing a laboratory test stand. Investigate amount of chemicals carried onboard the air (U) In FY 2005: Conduct follow-on demonstration | odine injection, chemical recin rcraft. tions of advance | and advanced culation on tac | chemical oxyg etical airborne p eration, iodine i | gen iodine test se platforms to great injection, and ac | equence atly reduce the lvanced | | | | | |
| chemical oxygen iodine test sequence utiliz into a laser device to predict overall device- | | | | | | | | | | |
| Project 3647 | iever perioritia | | - | No. 29-16 of 29-1 | - | | | Exhibit R-2a (| PF 0603605F) | |
| j 00 | | | 447 | | - | | | | | |

| | Exhibit R-2a, RDT&E Project | Justification | DAT | February | 2004 |
|------------|--|--|-------|----------------------------------|--------------|
| | GET ACTIVITY Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603605F Advanced Weapons Technology | | MBER AND TITLE Energy Laser T | echnology |
| | demonstrations of closed-cycle chemical approaches for use on tactical airborne | platforms. | | | |
| (U) (U) | MAJOR THRUST: Develop and evaluate beam control and compensation techn atmospheric attenuation and distortion of high energy laser beams propagating f | | 3.564 | 2.038 | 1.929 |
| (U) | In FY 2003: Completed experimental testing of advanced active tracking and at Conduct field testing of advanced beam control architectures against a scaled tar improvements to support Airborne Laser block upgrades. Refined, through mo- front sensors and the two-beacon concept. Transitioned appropriate technology Program Office. | rget. Assessed advanced technology deling and simulation, improved wave | | | |
| (U) | | nvironments. Demonstrate, in the orrect for atmospheric disturbances. 1 technique. Anchor wave optics | | | |
| (U) | In FY 2005: Complete beam control technology demonstration and transition of Laser System Program Office. | f these technologies to the Airborne | | | |
| (U) (U) | MAJOR THRUST: Performed vulnerability assessments on potential high energies design data for laser systems, both to defeat these targets and to understand the p targets in the area. | | 0.371 | 0.000 | 0.000 |
| (U) (U) | In FY 2003: Updated target system response databases for improved predictive In FY 2004: Not Applicable. In FY 2005: Not Applicable. | avoidance analyses. | | | |
| | CONGRESSIONAL ADD: Sodium Wavelength Laser. In FY 2003: Fabricated brassboard sodium-wavelength laser to be use as mesos systems on large-aperture telescopes to significantly increase atmospheric comp effects to much higher altitudes. Achieved 21 watts output power and generated guidestar. Completed series of field tests and experiments to characterize sodium outputs of 1-21 watts, with and without atmospheric compensation. Designed, p 50 watt laser. | ensation of laser beams by measuring 1 magnitude 7.1 mesospheric sodium m guidestar radiometry using laser | 2.177 | 0.000 | 0.000 |
| | In FY 2004: Not Applicable. In FY 2005: Not Applicable. | | | | |
| | | ist - Item No. 29-17 of 29-19 | | Exhibit R-2a (F | PE 0603605F) |
| | | 448 | | | |

| BUDGET ACTIVITY 03 Advanced Technology Developmen (U) | t (ATD) | 2a, RDT&E | | PE NUMBER A | ND TITLE | | | February | 2004 |
|--|--|--|--|---|---|-----------------------------------|---------------|--|-------------------|
| 03 Advanced Technology Developmen (U) | | | | | ND TITLE | | | | |
| | ~ | | | Technology | dvanced Wea | pons | | TNUMBER AND TITLE gh Energy Laser 1 | echnology |
| (U) CONGRESSIONAL ADD: Laser Spark (U) In FY 2003: Not Applicable. (U) In FY 2004: Perform laboratory effects of different focal plane arrays and expan additional focal plane array type. Perfor pulse length regime. Perform and docur Design, fabricate, and use a brass board effectiveness of the Spark countermeasu a single threat independent pulse format (U) In FY 2005: Not Applicable. | tests and mo ad the databa rm laboratory nent a counte countermeas re (at relativ | odeling to resolv se to include add y effects testing ermeasure effect sure laser system | ditional pulse let to extend previo tiveness study fo n in a field demo | erences in the da ngth data and at ous results into th or selected opera onstration test to | amage threshold least one ne ultra short ttional scenarios show the | | 0.000 | 4.300 | 0.000 |
| (U) Total Cost | | | | | | | 8.085 | 8.595 | 4.514 |
| (U) <u>C. Other Program Funding Summary</u> (U) Related Activities: PE 0602605F, Directed Energy Technology. (U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment. PE 0602500F, (U) Multi-Disciplinary Space Technology. PE 0603500F, (U) Multi-Disciplinary Advanced Development Space Technology. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. (U) The technology efforts in this | Y (S IN MILLIO FY 2003 Actual | <u>FY 2004</u> Estimate | FY 2005 Estimate | FY 2006 Estimate | <u>FY 2007</u> <u>Estimate</u> | <u>FY 2008</u> <u>Estimate</u> | FY 2 Estir | | <u>Total Cost</u> |
| Project 3647 | | R- | 1 Shoppina List - I | tem No. 29-18 of 2 | 29-19 | | | Exhibit R-2a (| PE 0603605F) |

| Exhibit R-2a, RDT&E P | roject Justification | DATE February 2004 |
|--|--|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603605F Advanced Weapons Technology | NUMBER AND TITLE gh Energy Laser Technology |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> PE that are supporting future enhancements to airborne lasers have been coordinated with the Airborne Laser program office. | | |
| (U) D. Acquisition Strategy Not Applicable. | | |
| Project 3647 R-1 | Shopping List - Item No. 29-19 of 29-19 | Exhibit R-2a (PE 0603605F) |

PE NUMBER: 0603723F PE TITLE: Environmental Engineering Technology

| | Exhib | oit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 |
|------------------|---|-----------------|----------------|-------------------|-----------------------------|-------------------------------------|--|-----------------|--|------------------------------------|
| | ET ACTIVITY Ivanced Technology Development (/ | ATD) | | | E NUMBER AND 603723F Env | | ngineering T | echnology | <u> </u> | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | · · · · · · | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| | Total Program Element (PE) Cost | 1.152 | 1.190 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | TB |
| 103 | Environmental Quality Technology In FY 2000, the Air Force terminated this | 1.152 | 1.190 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | |
| J) | n for Bioreactor Technologies Evaluation a <u>A. Mission Description and Budget Iten</u> This program develops and demonstrates a problems. | n Justification | | | | | | - | | on |
| | This program is in Budget Activity 3, Adv problems. B. Program Change Summary (\$ in Mil | | ogy Developm | ent, since it dev | velops and dem | | iced technologi FY 2003 | es to address A | | |
| • | | | | | | | | | | <u>FY 2005</u> |
| | Previous President's Budget | | | | | | 1.187 | 0 | 0.000 | 0.000 |
|) | Current PBR/President's Budget | | | | | | 1.187 1.152 | 1 |).000 1.190 | 0.000 |
|) | Current PBR/President's Budget Total Adjustments | | | | | | 1.187 | 1 | 0.000 | 0.000 |
|))) | Current PBR/President's Budget Total Adjustments Congressional Program Reductions | | | | | | 1.187 1.152 | C 1 1 |).000 1.190 1.190 | 0.000 |
| D D D | Current PBR/President's Budget Total Adjustments | | | | | | 1.187 1.152 | -C |).000 1.190 | 0.000 |
| ル ル ル | Current PBR/President's Budget Total Adjustments Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings SBIR/STTR Transfer | | | | | | 1.187 1.152 | -C |).000 .190 .190).010 | 0.000 |
| ע ע ע ע | Current PBR/President's Budget Total Adjustments Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings | lysis and Repor | ting Network (| E-SMART) in | FY 2000, adde | ironmental Qua d \$1.0 million : | 1.187 1.152 -0.035 -0.035 dity Technolog for Joint Enviro | y and added \$4 | 0.000 1.190 1.190 0.010 1.200 4.0 million for t n-Up in FY 200 | 0.000 0.000 the 01, added |

| | ExI | hibit R-2a, I | RDT&E Pro | ject Justif | fication | | | DAT | February | 2004 | |
|-------------------|---|------------------------|------------------------|-------------------|---|----------------|-----------------|-----------------|-----------------|-------------------|--|
| | GET ACTIVITY dvanced Technology Development (| (ATD) | | | 0603723F Environmental Engineering 2103 E | | | | nology | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | |
| 2103 | | 1.152 | 1.190 | 0.000 | | 0.000 | 0.000 | | | TBD | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | (|) | | |
| (U) | A. Mission Description and Budget Iter This program develops and demonstrates problems. This program is in Budget Activity 3, Adv problems. | advanced techn | - | | - | - | | - | - | | |
| (U) (U) (U) | | | | | | | | | | | |
| | Total Cost | | | | | | | 1.152 | 1.190 | 0.000 | |
| (U) | C. Other Program Funding Summary (S | <u>\$ in Millions)</u> | | | | | | | | | |
| | FY | <u>2003</u> <u>FY</u> | <u>7 2004</u> <u>F</u> | Y 2005 | <u>FY 2006</u> | <u>FY 2007</u> | FY 2008 | FY 2009 | Cost to | <u>Total Cost</u> | |
| (U) (U) (U) | Related Activities: PE 0602102F, Materials. PE 0602202F, Human Effectiveness Applied Research. PE 0602203F, Aerospace Propulsion. PE 0603112F, Advanced Materials for Weapon Systems. PE 0603211F, Aerospace Structures. | <u>Actual E</u> | <u>stimate F</u> | Estimate | <u>Estimate</u> | Estimate | <u>Estimate</u> | <u>Estimate</u> | <u>Complete</u> | 1000 2000 | |
| Proj | ect 2103 | | R-1 Sh | opping List - Ite | m No. 30-2 of 30-3 | 3 | | | Exhibit R-2a (I | PE 0603723F) | |
| | | | | 45 | 2 | | | | | | |

| Exhibit R-2a, RDT&E | Exhibit R-2a, RDT&E Project Justification | | | | | | | |
|--|---|--|--------------------------|--|--|--|--|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | 0603723F Environmental Engineering | | | | | | | |
| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> PE 0603231F, Crew Systems (U) and Personnel Protection Technology. PE 0603716D, Strategic (U) Environmental Research and Development Program. PE 0603851D, Environmental (U) Security Technology Certification Program. (U) Security Technology Certification Program. (U) PE 0604706F, Life Support Systems. (U) PE 0604708F, Other Operational Equipment. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication. | | | | | | | | |
| (U) D. Acquisition Strategy Not Applicable. | | | | | | | | |
| Project 2103 | R-1 Shopping List - Item No. 30-3 of 30-3 | | Exhibit R-2a (PE 0603723 | | | | | |

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PE NUMBER: 0603789F PE TITLE: C3I Advanced Development

| | Exhibit R-2, RDT&E Budget Item Justification | | | | | | | | | 2004 |
|------------|---|---------------|----------|----------|----------|------------|----------|----------|---------------|-------|
| | BUDGET ACTIVITY PE NUMBER AND TITLE 13 Advanced Technology Development (ATD) PE NUMBER AND TITLE 14 O603789F C3I Advanced Development | | | | | | | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| | Total Program Element (PE) Cost | 43.160 | 44.917 | 28.524 | 30.832 | 38.144 | 30.744 | 33.193 | Continuing | TBI |
| 4072 | Dominant Battlespace Awareness | 23.105 | 24.894 | 11.785 | 11.987 | 16.087 | 13.191 | 13.090 | Continuing | TBL |
| 4216 | Battlespace Information Exchange | 9.596 | 9.352 | 6.469 | 6.522 | 6.642 | 6.753 | 6.862 | Continuing | TBL |
| 4872 | Aerospace Information Dominance | 8.680 | 8.424 | 8.390 | 10.426 | 13.483 | 8.836 | 11.245 | Continuing | TBI |
| 4925 | Collaborative Info Superiority | 1.779 | 2.247 | 1.880 | 1.897 | 1.932 | 1.964 | 1.996 | Continuing | TBI |
| T T | | G2 1 E | | 1 | X C | D . | 1 | a 11 1 | GA 1 1 | |

Note: In FY 2004 Project 4872, Dynamic Aerospace C2 and Execution, changed to Aerospace Information Dominance, and Project 4925, Collaborative C2, changed to Collaborative Info Superiority.

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates Aerospace Command, Control, Communications, and Intelligence (C3I) technologies for the warfighter. The technologies address the ability to support the global information exchange of correlated and fused information to ensure the Air Force can plan and execute missions in a dynamic environment. The Dominant Battlespace Awareness project will provide affordable operational data capabilities for personnel to understand militarily relevant situations, on a consistent basis, with the precision and timeliness needed to accomplish the mission. The Battlespace Information Exchange project will develop the reliable, secure, jam-resistant, inter-operable worldwide global information enterprise capabilities, providing the Air Force assured communications and reach-back capability in a joint/coalition environment. The Aerospace Information Dominance project provides the technology and demonstrations needed to allow the warfighter to plan, assess, execute, monitor, and re-plan on the compressed time scales required for tomorrow's conflicts, whether they be combat or peacekeeping missions. The Collaborative Information Superiority project provides the technology and demonstrations needed to establish virtual, distributed Air Operations (AOC), allowing the majority of the AOC resources to remain in the Continental United States, while only a small command element is deployed forward. The resultant products of this program will be technologies needed to build the capability to dynamically plan and replan over a secure network. Note: In FY 2004, Congress added \$3.0 million for Fusion Signals Intelligence Enhancements for Network Centric Intelligence, Surveillance and Reconnaissance, \$2.0 million for Automatic Acoustic Target Recognition, \$4.8 million for Information Authentication and Protection, and \$1.0 million for Effects-Based Operations. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing upgrades and/or

Exhibit R-2 (PE 0603789F)

| | Exhibit R-2, RDT&E Bu | dget Item Justification | DATE February 2004 | | |
|-----|--|--|-----------------------|----------------|--|
| - | GET ACTIVITY dvanced Technology Development (ATD) | PE NUMBER AND TITLE 0603789F C3I Advanced Development | | | |
| (U) | B. Program Change Summary (\$ in Millions) | | | | |
| | | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | |
| U) | Previous President's Budget | 45.030 | 31.538 | 28.599 | |
| U) | Current PBR/President's Budget | 43.160 | 44.917 | 28.524 | |
| U) | Total Adjustments | -1.870 | 13.379 | | |
| U) | Congressional Program Reductions | | -0.037 | | |
| | Congressional Rescissions | | -0.384 | | |
| | Congressional Increases | | 13.800 | | |
| | Reprogrammings | -0.626 | | | |
| | SBIR/STTR Transfer | -1.244 | | | |
| U) | Significant Program Changes: | | | | |
| | Not Applicable. | | | | |

| | Ext | nibit R-2a, F | ≀DT&E Pro | ject Justif | stification | | | | DATE February 2004 | | |
|------|---|---------------|-----------|-------------|-----------------------------------|----------|----------|--|-----------------------|-------|--|
| | BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | | | | 0603789F C3I Advanced Development | | | PROJECT NUMBER AND TITLE 4072 Dominant Battlespace Awareness | | | |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total | |
| | Cost (\$ III Willions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | | |
| 4072 | Dominant Battlespace Awareness | 23.105 | 24.894 | 11.785 | 11.987 | 16.087 | 13.191 | 13.090 | Continuing | TBD | |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| | | | | | | | | | | | |

(U) <u>A. Mission Description and Budget Item Justification</u>

This project develops, integrates, and demonstrates advanced technologies to achieve Dominant Battlespace Awareness (DBA) and Predictive Battlespace Awareness (PBA) using information from all sources, exploiting government and commercial technologies in support of the Global Strike Task Force and the Space and Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) Task Force. DBA is the information required to support dynamic planning and execution with the accuracy, fidelity, and timeliness needed to dominate in battle. Technology development includes: tasking information collectors (intelligence, surveillance, and reconnaissance (ISR) platforms, national intelligence sources, etc.); correlating and geo-registering the collected data; exploiting the data to extract information of military significance; fusing information from multiple sources to create a digital representation of the battlespace; assessing the situation; predicting enemy course of action; and archiving the results for ready use by decision makers. This is a dynamic process that involves technologies for information access, extraction, fusion, processing, storage, and retrieval, as well as technologies for machine reasoning, pattern recognition, and timeline analysis.

| (U) | <u>B. Accomplishments/Planned Program (\$ in Millions)</u> | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
|-----|--|----------------|----------------|----------------|
| (U) | MAJOR THRUST: Develop and demonstrate advanced data handling and event visualization technologies. | 4.411 | 4.135 | 3.391 |
| (U) | In FY 2003: Developed and demonstrated automated capabilities to access, extract, process, and display fused | | | |
| | multi-source intelligence for in-time situational awareness. Developed tools for timeline, event, and motion pattern | | | |
| | recognition to support analysis, visualization, and decision aids to detect enemy activity. Developed probabilistic | | | |
| | approaches for accumulation of data/information to support target/activity identification and situational awareness. | | | |
| | Developed a capability for precise geo-location and identification of targets exploiting multi-sensor data. Developed | | | |
| | technologies to use multiple source correlation of sensor reports to optimize allocation of sensor resources. | | | |
| (U) | In FY 2004: Develop and deliver probabilistic approaches for accumulation of data/information to support | | | |
| | target/activity identification and situational awareness, in support of Predictive Battlespace Awareness (PBA). | | | |
| | Complete development of the interface required to feed fused sensor information and derived higher levels of | | | |
| | intelligence, such as enemy force structures, lines of communications, and possible courses of actions, into | | | |
| | effects-based operations tools and decision aids. Continue development of tools for timeline, event, and motion | | | |
| | pattern recognition to support analysis, visualization, and decision aids to detect enemy activity. Initiate development | | | |
| | of an operations-based approach for intelligent and adaptive intelligence, surveillance, and reconnaissance (ISR) | | | |
| | management, based upon quantified information deficiencies in the fused data-space. Initiate development of a fusion | | | |
| | evaluation environment and provide the analysis, evaluation, and transition of fusion products to the warfighter. | | | |
| (U) | In FY 2005: Complete probabilistic approaches for accumulation of data/information to support target/activity | | | |
| | identification and situation awareness in support of PBA. Complete development and deliver tools for timeline, event | | | |
| Pro | ject 4072 R-1 Shopping List - Item No. 31-4 of 31-19 | | Exhibit R-2a | (PE 0603789F) |
| | 457 | | | |

| Exhibit R-2a, RDT&E F | Exhibit R-2a, RDT&E Project Justification | | | | | | |
|---|--|------------|---|-------|--|--|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603789F C3I Advanced Developme | ent 4072 D | ROJECT NUMBER AND TITLE 172 Dominant Battlespace wareness | | | | |
| and motion pattern recognition to support analysis, visualization and to develop an Operations-based approach for intelligent and adaptive information deficiencies in the fused data-space. Continue to develop environment, providing for the analysis, evaluation, and transition of (U) | ISR management, based upon quantified p and deliver an initial fusion evaluation | | | | | | |
| (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and demons technologies for detection, tracking, identification, and targeting of tin technologies for situational awareness. Note: This effort includes \$2. funding for Fusion Signals Intelligence (SIGINT) Enhancements to E 2004 Congressional Add funding for Fusion SIGINT Enhancements for | ime-critical targets, and information extraction .8 million in FY 2003 Congressional Add Electronic Intelligence and \$3.0 million for FY for Network Centric ISR. | 7.597 | 7.590 | 2.992 | | | |
| (U) In FY 2003: Developed tools to extract information from data derive intelligence (MASINT). Developed and demonstrated information ex and their relationships from free form text, allowing the warfighter m | xtraction tools that automatically extract events | | | | | | |
| (U) In FY 2004: Complete the development of tools to extract information measurement and MASINT. Continue to develop and demonstrate in extract events and their relationships from free text, including human sources, allowing the warfighter more time to perform analysis. Initia advanced ISR platforms that provide the detection and tracking of air tools for the exploitation of High Range Resolution, Identification Fri characteristics for feature-aided tracking and targeting. Start develop support collection planning for ISR platforms. | on from data derived from image, and nformation extraction tools that automatically a intelligence and communication intelligence tate development of an exploitation toolkit for r and ground targets. Initiate investigation of riend or Foe, and Synthetic Aperture Radar sensor oment of automated sensor management tools to | | | | | | |
| (U) In FY 2005: Complete development and demonstration of intermedia development of advanced text exploitation tools that automatically ex text, including human intelligence and communication intelligence so perform analysis. Continue the development and deliver an exploitati surveillance, and reconnaissance (ISR) platforms that provide the dete Deliver tools for the exploition of High Range Resolution, Identificat sensor characteristics for feature aided tracking and targeting. Contin management tools to support collection planning for ISR platforms. I dynamic tasking of ISR assets (Unmanned Aireal Vehicle/Manned/Sp and fusion of multi-source/multi-platform information, in order to pro- intelligence to allied/coalition forces. | xtract events and their relationships from free ources, allowing the warfighter more time to tion toolkit for advanced intelligence, tection and tracking of air and ground targets. tion Friend or Foe, and Synthetic Aperture Radar nue to develop and deliver automated sensor Initiate development of algorithms for the pace ISR collectors) based upon the exploitation | | | | | | |
| (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and demons | strate advanced data and information fusion | 11.097 | 13.169 | 5.402 | | | |
| · · · | 1 Shopping List - Item No. 31-5 of 31-19 | | Exhibit R-2a (I | | | | |

| Exhibit R-2a | DATE | DATE February 2004 | | | | | | |
|--|--|--|---|-----------------------------------|-----------------------------------|-------------------|--|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | | | | | | | | |
| capabilities to support multi-source capabilities, new see management. Note: This effort includes \$1.75 million funding for Automatic Acoustic Target Recognition an Congressional Add funding for Identification of Time-(U) In FY 2003: Developed and demonstrated an all-source time-critical targets. Demonstrated fusion systems and fix, identify, and track moving air and ground targets, a concealment, and deception techniques. Developed furprovide higher levels of intelligence such as enemy for action. Initiated collaborative collection and fusion of improve accuracy and timeliness for situational awarer (U) In FY 2004: Demonstrate and deliver an all-source ad targets that employ camouflage, concealment, and dece system architectures capable of exploiting multiple sour warnings, and time-critical target identification and trat tools to exploit fused sensor information to provide hig of communications, and possible courses of action. Communications, and possible courses of action. Communications and possible courses of action and trates are acapability for fusing signal intelligence, data for the detection and tracking of time-critical targets within the context of a continuously changing b techniques for reasoning about enemy movements and information, to be able to find, identify, and track diffind deception techniques. Initiate an investigation of reasoning about enemy movements and information. | n in FY 2003 and \$2.0 million nd \$3.9 million in FY 2003 and Critical Targets. ce advanced capability for the d architectures capable of expl and to detect and track targets sion algorithms and tools to e rece structures, lines of commu intelligence, surveillance, and ness and targeting. vanced capability for the dete eption techniques. Complete arces of data to provide situati acking. Complete the develop gher levels of intelligence, suc complete the collaborative colle uational awareness and targeti moving target indicator, folia ets. nee data mining and reasoning pattlefield environment. Initia actions, from historical datab cult targets that employ conce | in FY 2004 Congression d \$4.8 million in FY 200 detection and tracking of oiting multiple sources to employing camouflage, xploit fused sensor inform nication, and possible co l reconnaissance information ction and tracking of time the demonstration of fusion al awareness, indication ment of fusion algorithm h as enemy force structure ection and fusion of ISR ng. Develop, complete, ge penetrating radar, and techniques to locate har te development of appro- ases and real-time multi- alment, camouflage, and | hal Add 44 f o find, mation to burses of ation to e-critical ion ons and is and res, lines and t imagery d to find aches and e-source | | | | | |
| dynamics of the battlefield. (U) Total Cost | | | | 23.105 | 24.894 | 11.785 | | |
| (U) <u>C. Other Program Funding Summary (\$ in Million</u> | | | | | | | | |
| (U) Related Activities: (U) PE 0602702F, Command, | FY 2004FY 2005EstimateEstimate | FY 2006FY 2EstimateEstimate | 2007 <u>FY 2008</u> mate <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> | | |
| (U) Control, and Communications | | | | | | | | |
| Project 4072 | R-1 Shopping List - | | | | Exhibit R-2a | | | |

| Exhibit R-2a, RDT&E P | DATE February 2004 | | |
|---|---|--------|---|
| UDGET ACTIVITY 3 Advanced Technology Development (ATD) | 0603789F C3I Advanced Development | | T NUMBER AND TITLE ominant Battlespace |
| J. C. Other Program Funding Summary (\$ in Millions) J. PE 0603203F, Advanced Aerospace Sensors. J. PE 0603742F, Combat Identification Technology. This project has been coordinated through the J. Reliance process to harmonize efforts and eliminate duplication. J. D. Acquisition Strategy Not Applicable. | | Awarei | ness |
| Project 4072 R-1 | Shopping List - Item No. 31-7 of 31-19 460 | | Exhibit R-2a (PE 060378 |

| | ExI | hibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|--|--|---|--|---|--|---|--|--|--|---|
| | ET ACTIVITY Ivanced Technology Development (| (ATD) | | | E NUMBER AND 603789F C3I | Advanced De | evelopment | PROJECT NUME 4216 Battlesj Exchange | | tion |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 4216 | Battlespace Information Exchange | 9.596 | 9.352 | 6.469 | 6.522 | 6.642 | 6.753 | 6.862 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | A. Mission Description and Budget Iter This project develops and demonstrates as near-real-time multimedia (i.e., voice, dat mobile, interoperable, and seamless betwo and multi-national force boundaries; b) su in-transit visibility of en route aircraft, car information and mission changes to en ro management, multi-level secure commun transmission systems. | dvanced commu ta, video, and im een aircraft, eith apport mobile in rgo, mission stat ute aircraft). Teo | agery) information er en route or f formation super us, and reachb chnology deve | ation in a joint/ in theater, and a eriority, sensor- back capabilitie lopments inclue | coalition enviro Air Operations -to-shooter oper s for aircraft to de an informati | onment. This se Centers. It will rations, and the operations cent on assurance de | ecure informati l: a) provide in battle manages ters in the Cont ecision support | on grid will be teroperability a ment decision p tinental United system, advance | rapidly deploy cross echelon, process; and c) States (i.e., up ced information | able, Service, provide dating 1 |
| (U) M (U) I in c C n | B. Accomplishments/Planned Program (MAJOR THRUST: Develop and demonst esources for global reach in the Air Mobil n FY 2003: Demonstrated an Intelligent I nformation flow among AMC components omponents of Intelligent Information Mar Controller to produce a combined commer tetwork, and an intelligent heterogeneous nvironment. | rate advanced ex lity Command (A Information Mar s based on chan; nager, Integrated cial/military glo | AMC) environ aager agent tha ging system ca l Network Con bal communic | ment. at will throttle a pabilities. Intentroller, and the ations system, a | nd regulate mis grated the airbo Global Media a dynamically s | ssion orne Access switched | | <u>2003</u> 1.152 | <u>FY 2004</u> 1.329 | <u>FY 2005</u> 1.795 |
| f v s c C n e (U) I | n FY 2004: Finalize and demonstrate adv or global reach in the AMC environment. will autonomously throttle and regulate mi ystem capabilities. Complete Phase 1 inte omponents of the Intelligent Information Controller to produce a combined commer- network, and an intelligent heterogeneous nvironment. n FY 2005: Further develop the Intelligen Media Access Controller into a software ap | Complete and a ssion informatic egration in an A Manager, Integr cial/military glo database access nt Information M | lemonstrate an on flow among MC airlifter (c ated Network bal communic interface to pr lanager, Integr | a intelligent info AMC compon arry-on capabil Controller, and ations system, ioritize and cor rated Network (| ormation managents based on c lity) of the airbo l the Global Me a dynamically s ntrol resources i | ger agent that hanging orne dia Access switched in a mobility the Global | | | | |
| Proje | ct 4216 | | R-1 Sh | opping List - Item | n No. 31-8 of 31-1 | 9 | | | Exhibit R-2a (| PE 0603789F) |

| BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND TITLE 03 Advanced Technology Development (ATD) D03789F C31 Advanced Development 2476 Battlespace Information Exchange (U) MAURE THRUST: Develop advanced network protocols and commercial management technologies to provide communications from deployed aircraft and ground elements to the Air Mobility Command (AMC) Tanker Airlift Control Center (TACC), as well as in-transit visibility at the TACC of all aircraft, personnel, and cargo. 1.160 1.654 0.000 10) In FY 2003: Demonstrate technology to dynamically reconfigure the network and communications systems to optimally match the requirements for information transfer with changing transmission path availability. Controller, and Cliobal Media Access Controller in AMCS TACC and AMCS forward deployed unit, the Tanker Airlin Control Element, resulting in a seamless information infrastructure providing total asset visibility and enhanced Statutand awareness. 1.176 1.654 0.000 (U) In YY 2004: Complete the demonstration of technology to dynamically reconfigure the network and communications systems to optimally match the requirements for information transfer with changing transmission path availability. Complete development and integrated on these for information infrastructure, providing total asset visibility and enhanced situational awareness. 0.950 1.809 0.000 (U) In YY 2005: Not Applicable. Effort will be completed in the requirement entwork transport services, hased on mission profinitis. Complete the daptive communications control | | Exhibit R-2a, RDT&E Project Just | DATE February 2004 | | | |
|--|-----|--|--|--------|------------------------|---------|
| (1) MAJOR THRUST: Develop advanced network protocols and commercial management technologies to provide communications from deployed aircraft and ground elements to the Air Mobility Command (AMC) Tanker Airlift Control Center (TACC), as well as in-transit visibility at the TACC of all aircraft, personnel, and cargo. (1) In FY 2003: Demonstrated technology to dynamically reconfigure the network and communications systems to optimally match the requirements for information transfer with changing transmission path availability. Integrated and demonstrated the ground-based components of the Intelligent Information Manager, Integrated Network Controller, and Global Media Access Controller in AMCS TACC and AMCS forward deployed unit, the Tanker Airlift Control Element, resulting in a seamless information infrastructure providing total asset visibility and enhanced situation awareness. (11) In FY 2004: Complete the demonstration of technology to dynamically reconfigure the network and communications systems to optimally match the requirements for information transfer with changing transmission path availability. Complete development and integration of mechanisms that intelligently and dynamically negotiate quality of service and handwidth between applications and network transport services based on mission priorities. Continue to integrate and demonstrate additional avareness. (11) In FY 2005: Not Applicable. Effort will be completed in FY 2004. (12) (13) In FY 2005: Not Applicable. Effort will be completed in FY 2004. (14) In FY 2003: Completed the adaptive communications and network transport services, based on mission priorities. Completed development of affordable multi-level secure network management technologies that provide reliable efficient, secure, interoperable, and dynamic deployable communications. (15) In FY 2003: Completed the adaptive communications and network transport services based on mission priorities. Completed development an | | Advanced Technology Development (ATD) | | 4216 B | attlespace Information | |
| (II) MAJOR THRUST: Develop advanced network protocols and commercial management technologies to provide communications from deployed aircraft and ground elements to the Air Mobility Command (AMC) Tanker Airlift Control Center (TACC), as well as in-transit visibility at the TACC of all aircraft, personnel, and cargo. (II) In IPY 2003: Demonstrated technology to dynamically reconfigure the network and communications systems to optimality match the requirements for information transfer with changing transmission path availability. Integrated and demonstrated the ground-based components of the Intelligent Information Manager, Integrated Network Control Element, resulting in a seamless information infrastructure providing total asset visibility and enhanced situation awareness. (II) In FY 2004: Complete the demonstration of technology to dynamically reconfigure the network and communications systems to optimally match the requirements for information transfer with changing transmission path availability. Complete development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services based on mission priorities. Continue to integrate and demonstrate additional capabilities for ground-based components of the Intelligent Information Manager, Intelligent Network Controller, and Global Media Access Controller into AMC, Air Combat Command, and other DoD users' communications architecture, resutiling in a seamless information infrastructure, providing total asset visibility and enhanced situational awareness. (II) In FY 2003: Not Applicable. Effort will be completed in FY 2004. (II) In FY 2003: Completed the adaptive communications controller system(s), integrating additional and emerging media types for increased bandwidth between applications and network transport services based on mission priorities. Completed the adaptive communication fragmating and record trecords and andev | aD | capability to the Joint Tactical Radio System clusters. | | | | |
| optimally match the requirements for information transfer with changing transmission path availability. Integrated and demonstrated the ground-based components of the Intelligent Information Manager, Integrated Network Controller, and Global Media Access Controller in AMCS TACC and AMCS forward deployed unit, the Tanker Airlift Control Element, resulting in a seamless information infrastructure providing total asset visibility and unhanced situation awareness. Up In FY 2004: Complete the demonstration of technology to dynamically reconfigure the network and communications systems to optimally match the requirements for information transfer with changing transmission path availability. Complete development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services based on mission priorities. Continue to integrate and demonstrate additional capabilities for ground-based components of the Intelligent Information Manager, Intelligent Network Controller, and Global Media Access Controller into AMC, Air Combat Command, and other DoD Dors completed situational awareness. 0.950 1.809 0.000 (U) In FY 2005: Not Applicable. Effort will be completed in FY 2004. 0.950 1.809 0.000 (U) In FY 2003: Completed the adaptive communications controller system(s), integrating additional and emerging media types for increased bandwidth between applications and network management technologies that provide reliable efficient, secure, interoperable, and deployable communications. 0.950 1.809 | · / | communications from deployed aircraft and ground elements to the Air Mobility Com | nmand (AMC) Tanker Airlift | 1.160 | 1.654 | 0.000 |
| systems to optimally match the requirements for information transfer with changing transmission path availability. Complete development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services based on mission priorities. Continue to integrate and demonstrate additional capabilities for ground-based components of the Intelligent Information Manager, Intelligent Network Controller, and Global Media Access Controller into AMC, Air Combat Command, and other DoD users' communications architecture, resulting in a seamless information infrastructure, providing total asset visibility and enhanced situational awareness. (U) In FY 2005: Not Applicable. Effort will be completed in FY 2004. (U) MAJOR THRUST: Develop and demonstrate improved global networking and resource management technologies 0.950 1.809 0.000 that provide reliable efficient, secure, interoperable, and dynamic deployable communications. (U) In FY 2003: Completed the adaptive communications controller system(s), integrating additional and emerging media types for increased bandwidth between applications and network transport services based on mission priorities. Completed development of affordable multi-level secure network management capabilities to provide commanders with status and control of information grid network resources. (U) In FY 2004: Complete the development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services, based on mission priorities. Develop and demonstrate advanced cross-domain network management technology for enabling the exchange of network management, command and control applications status, and in | (U) | optimally match the requirements for information transfer with changing transmission and demonstrated the ground-based components of the Intelligent Information Manage Controller, and Global Media Access Controller in AMC's TACC and AMC's forward Airlift Control Element, resulting in a seamless information infrastructure providing to | n path availability. Integrated er, Integrated Network d deployed unit, the Tanker | | | |
| (U) MAJOR THRUST: Develop and demonstrate improved global networking and resource management technologies 0.950 1.809 0.000 that provide reliable efficient, secure, interoperable, and dynamic deployable communications. 0 In FY 2003: Completed the adaptive communications controller system(s), integrating additional and emerging media types for increased bandwidth capability. Developed and integrated mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services based on mission priorities. Completed development of affordable multi-level secure network management capabilities to provide commanders with status and control of information grid network resources. 0 In FY 2004: Complete the development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services, based on mission priorities. 0 In FY 2004: Complete the development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services, based on mission priorities. 0 In FY 2004: Complete the development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services, based on mission priorities. 0 In FY 2004: Complete the development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications status, and information assurance events, across security domains. Develop and demonstrate a highly flexible real-time controlled interface that parses and filters protocol | (U) | systems to optimally match the requirements for information transfer with changing t Complete development and integration of mechanisms that intelligently and dynamic and bandwidth between applications and network transport services based on mission and demonstrate additional capabilities for ground-based components of the Intelligent Intelligent Network Controller, and Global Media Access Controller into AMC, Air C DoD users' communications architecture, resulting in a seamless information infrastru | ransmission path availability. ally negotiate quality of service priorities. Continue to integrate nt Information Manager, Combat Command, and other | | | |
| (U) MAJOR THRUST: Develop and demonstrate improved global networking and resource management technologies (U) In FY 2003: Completed the adaptive communications controller system(s), integrating additional and emerging media types for increased bandwidth capability. Developed and integrated mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services based on mission priorities. Complete the development of affordable multi-level secure network management capabilities to provide commanders with status and control of information grid network resources. (U) In FY 2004: Complete the development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services, based on mission priorities. Develop and demonstrate advanced cross-domain network transport services, based on mission priorities. Develop and demonstrate advanced cross-domain network management technology for enabling the exchange of network management, command and control applications status, and information assurance events, across security domains. Develop and demonstrate a highly flexible real-time controlled interface that parses and filters protocol level information with a fine degree of granularity. This advanced cross domain technology will enable the eventual | | In FY 2005: Not Applicable. Effort will be completed in FY 2004. | | | | |
| (U) In FY 2003: Completed the adaptive communications controller system(s), integrating additional and emerging media types for increased bandwidth capability. Developed and integrated mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services based on mission priorities. Completed development of affordable multi-level secure network management capabilities to provide commanders with status and control of information grid network resources. (U) In FY 2004: Complete the development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network resources. (U) In FY 2004: Complete the development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services, based on mission priorities. Develop and demonstrate advanced cross-domain network management technology for enabling the exchange of network management, command and control applications status, and information assurance events, across security domains. Develop and demonstrate a highly flexible real-time controlled interface that parses and filters protocol level information with a fine degree of granularity. This advanced cross domain technology will enable the eventual | · / | | | 0.950 | 1.809 | 0.000 |
| quality of service and bandwidth between applications and network transport services, based on mission priorities. Develop and demonstrate advanced cross-domain network management technology for enabling the exchange of network management, command and control applications status, and information assurance events, across security domains. Develop and demonstrate a highly flexible real-time controlled interface that parses and filters protocol level information with a fine degree of granularity. This advanced cross domain technology will enable the eventual | (U) | In FY 2003: Completed the adaptive communications controller system(s), integratine media types for increased bandwidth capability. Developed and integrated mechanism dynamically negotiate quality of service and bandwidth between applications and net mission priorities. Completed development of affordable multi-level secure network | ng additional and emerging ms that intelligently and work transport services based on | | | |
| | (U) | In FY 2004: Complete the development and integration of mechanisms that intelliger quality of service and bandwidth between applications and network transport services Develop and demonstrate advanced cross-domain network management technology fr network management, command and control applications status, and information assu domains. Develop and demonstrate a highly flexible real-time controlled interface th | s, based on mission priorities. or enabling the exchange of arance events, across security at parses and filters protocol | | | |
| Project 4216 R-1 Shopping List - Item No. 31-9 of 31-19 Exhibit R-2a (PE 0603789F) | Pro | · · · · · · · · · · · · · · · · · · · | | | Exhibit R-2a (PE 06 | 03789F) |

| | Exhibit R-2a, RDT&E Proje | ect Justification | | DATE February 2004 | | |
|--|--|---|-------|-----------------------|--------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Develo | pment (ATD) | PE NUMBER AND TITLE 0603789F C3I Advanced Developme | | | | |
| development of a Network Comm security and health of the multi-le(U) In FY 2005: Not Applicable. Ef | | areness to assist in gauging the overall | | | | |
| (U) | tort will be completed in 1 1 2004. | | | | | |
| (U) MAJOR THRUST: Develop and provide assured, seamless, battles (U) In FY 2003: Developed and dem worldwide exchange of near-real- | demonstrate intelligent networking transp pace connectivity to the aerospace forces v onstrated technology to support an en rout time multimedia (i.e., voice, data, video, a t wideband technologies between airborne | with a greatly reduced footprint. e and in-theater information grid for the and imagery). Developed and | 1.255 | 1.123 | 1.895 | |
| (U) In FY 2004: Develop and demon automatically senses and adapts t | strate user-friendly, assured wideband wir o its environment and service demands. C | eless intelligent networking capability that conduct preliminary lab demonstration of a | | | | |
| (U) In FY 2005: Study, define, and d intelligent networking technology providing mission and context-ba | c among simulated airborne platforms. evelop mission and content delivery network, which will adapt to its environment and sed quality-of-service (QoS) routing. Me oS routing and fashion for ease of implement Service Laver. | varying demands for service, while orge wideband wireless intelligent | | | | |
| (U) | | | | | | |
| (U) MAJOR THRUST: Develop and | demonstrate secure wideband assured net) and integration with the developing airbo Project 4925. | | 0.000 | 0.000 | 2.294 | |
| (U) In FY 2003: Not Applicable. | | | | | | |
| of minature munitions. Data netw | rd affordable high-capacity data links that working will support command and control lamage-assessment with other weapon plat | | | | | |
| (U) | lamage-assessment with other weapon plat | noms. | | | | |
| (U) MAJOR THRUST: Develop and | demonstrate an enterprise management sy as and sources, monitors enterprise integrit | | 0.958 | 0.437 | 0.485 | |
| (U) In FY 2003: Completed develops and control (C2) assets within the application and network technological | air operations center C2 process. Develogies that provide the capability to monitor, | , understand, and maintain the status of | | | | |
| distributed C2 weapon systems. | Development of interface methodologies for | or seamless integration of theater battle | | | | |
| Project 4216 | R-1 Shopp | ing List - Item No. 31-10 of 31-19 | | Exhibit R-2a (F | PE 0603789F) | |

| | Exhibit R-2a, RDT&E Proje | ect Justification | DAT | February | 2004 |
|------------|--|---|-------|-----------------|--------------|
| - | GET ACTIVITY Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603789F C3I Advanced Develo | | MBER AND TITLE | |
| (U) (U) | management applications into the joint battlespace infosphere. In FY 2004: Initiate the development of an integrated command and control suite, comprised of common, scalable, and tailorable visualizations and man various fixed and deployed operations of command, control, and communic In FY 2005: Complete demonstration of an enterprise management system information from multiple systems in multiple security domains to display of compromising security in the individual domains. | nagement-control capabilities to support cations centers. that collects and evaluates status | | | |
| (U) (U) | MAJOR THRUST: Develop and demonstrate an information assurance ded defensive courses-of-action. In FY 2003: Developed and demonstrated an information assurance decision defensive courses-of-action relating to intrusion detection, intrusion response Demonstrated data correlation and data fusion tools for detection of large-se automatic forensics analysis of attack information. Developed the capability the threat level against the mission. Initiated development and demonstration counter measures. | on support system to provide real-time se, and information system recovery. cale coordinated attacks and provided ty to assess attacks and sophistication of | 0.921 | 0.000 | 0.000 |
| | In FY 2004: Not Applicable. Effort was discontinued due to higher Air Fo | pree priorities. | | | |
| (U) (U) | CONGRESSIONAL ADD: Information Protection and Authentication. In FY 2003: Developed and demonstrated information hiding, steganograp information protection and authentication systems. Developed steganograp detection and proofing, image and video content authentication, and secure investigation of new generation methods for digital security using steganog digital forgeries without watermarks. | bhic techniques for data embedding, tamper information dissemination. Began | 3.200 | 3.000 | 0.000 |
| | In FY 2004: Continue development and demonstration of information hidir watermarking for information protection and authentication systems. Continue techniques for data embedding, tamper detection and proofing, image and v information dissemination. Continue investigation of new generation methor steganographic techniques and for detection of digital forgeries without water and the steganographic techniques and for detection of digital forgeries without water | inue development of steganographic video content authentication, and secure ods for digital security using | | | |
| | In FY 2005: Not Applicable. Total Cost | | 9.596 | 9.352 | 6.469 |
| Pro | ject 4216 R-1 Shopp | bing List - Item No. 31-11 of 31-19 | | Exhibit R-2a (F | PE 0603789F) |

| | | DATE |
|---|--|---|
| Exhibit R-2a, RDT&E Pr | | February 2004 |
| UDGET ACTIVITY 3 Advanced Technology Development (ATD) | 0603789F C3I Advanced Development | T NUMBER AND TITLE attlespace Information nge |
| J) <u>C. Other Program Funding Summary (\$ in Millions)</u> | | |
| J) <u>D. Acquisition Strategy</u> Not Applicable. | | |
| | | |
| | | |
| | | |
| | | |
| Project 4216 R-1 St | nopping List - Item No. 31-12 of 31-19 | Exhibit R-2a (PE 060378 |

| | Ext | nibit R-2a, I | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|-----|--|--|---|---|--|--|--|---|--|--|
| | GET ACTIVITY Advanced Technology Development (| ATD) | | | PE NUMBER AND D603789F C3I | | evelopment | PROJECT NUME 4872 Aerospa Dominance | | ion |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| 487 | | Actual 8.680 | Estimate 8.424 | Estimate 8.390 | Estimate 10.426 | Estimate 13.483 | Estimate 8.836 | Estimate 11.245 | Complete Continuing | TBD |
| 407 | Quantity of RDT&E Articles | 0.000 | 0.424 | 0.590 | 0 | 0 | 0.050 | 0 | Continuing | |
| (U) | A. Mission Description and Budget Item In order to achieve information dominance dynamic environment. This project devel- needed to enable the warfighter to plan, as operations other than war. It will develop allowing the aerospace commanders to de realizing a strategy to task approach to aer distributed Information technologies that p Operations Center. Knowledge-based inter systems. | e for the Exped ops and demon ssess, execute, 1 and demonstra- termine the des rospace warfare provide the con | strates technolo nonitor, and re te a new gener ired operationa exploiting a li mander and st | ogies necessary plan on the con ation of planni al effects and p nk between co aff with seaml | of for dynamic dompressed time s ng assessment t rosecute the mis mmand, strateg ess access to tai | ecision making cales required f echnologies that ssion according y, and assessme lored multi-me | It provides the for tomorrow's at enable a new aly. It will deve ent functions. I dia, multi-spec | te technology a conflicts, whet paradigm of et elop innovative t will develop a tral data within | nd demonstrati her they be con ffects-based op capabilities ca and demonstration a mobile, dyna | ons mbat or verations, upable of e amic Air |
| (U) | B. Accomplishments/Planned Program (MAJOR THRUST: Develop and demonstr reconfigurable and provide seamless access mobile, dynamic C2 centers. | rate distributed s to tailored mu | lti-media, mult | i-spectral data | for commander | s and staff in | | 2003 2.067 | <u>FY 2004</u> 1.776 | <u>FY 2005</u> 2.693 |
| (U) | to enhance joint force battle plan simulation the battlespace infosphere. Deliver and de elements into an aerospace command cente planning, execution and assessment. Comp Program Office an integrated C2 system ca multi-spectral data for commanders and sta the C2 system. Initiate the design and deve | tle plan simulat e. Developed t er that provides Developed ember borative interac n, assessment, a emonstrate techner that provides plete and transit upability spiral t aff within the A | ion, assessment echnology that the Expedition added training t tion technology and implementat nology that inte the Expedition ion to the Thea hat provides se OC weapon sy- aseline of critic | t, and impleme integrates offe ary Aerospace technologies to y for adaptive ation, focused egrates offensi- ary Air Force a ater Battle Mar eamless access stem, allowing cal functionalit | entation focused ensive, defensive Force a cohesive provide rapid r visualization an on aerospace op ve, defensive, an a cohesive envir hagement Core S to tailored mult them to monito y and supportin | on aerospace e, and support ve environment nission d presentation perations within nd support conment for System i-media, or the status of g infrastructure | | | | |
| Pro | oject 4872 | | R-1 Sho | opping List - Item | No. 31-13 of 31- | 19 | | | Exhibit R-2a (| PE 0603789F) |

| Exhibit R-2a, RDT&E Pr | | DATE February 2004 | | |
|---|---|-----------------------|----------------|-------|
| BUDGET ACTIVITY 33 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603789F C3I Advanced Develo | | | |
| that will support the evolving Advanced Technology AOC weapon syste essential elements of information for the Advanced Technology AOC are representations that can be seamlessly exchanged across security bound. U) In FY 2005: Continue to design and develop a baseline of critical funct support the evolving Advanced Technology AOC weapon system and it develop a capability for the commander to monitor, and repair where ne superiority function within the AOC weapon system. Investigate the de supporting infrastructure of an Advanced Technology AOC weapon syste coordinate, and control air forces and operations across security boundar options generation capability for correcting failures and degradations with the Advanced Technology AOC weapon system. Initiate and develop h support information exchange between the Aerospace Operations Center Control Structure. | nd develop methodologies and information aries. cionality and supporting infrastructure that will ts split operations concept. Initiate and eccessary, the health of the information emonstration of a core set of functionality and stem enabling the ability to plan, direct, aries. Initiate and develop an automatic ithin the command and control (C2) system of highly efficient business processes and tools to | | | |
| U) | | | | |
| U) MAJOR THRUST: Develop and demonstrate the integration of plannir agents for adaptive replanning and decision support tools for aerospace U) In FY 2003: Developed and integrated planning and information-based Developed and demonstrated improved integrated flight management ca improved search, retrieval, and handling of data and information require resources. Developed and demonstrated continuous updating of the typ assets to improve situational awareness. | C2 systems. I intelligent agents for adaptive replanning. apabilities for mobility operations such as an ed for optimal use of available mobility | 2.107 | 1.553 | 0.399 |
| U) In FY 2004: Demonstrate improved integrated flight management capatimproved search, retrieval, and handling of data and information require resources. Complete the development of tools to continuously update ty assets to improve situational awareness. Demonstrate decision support define the defense transportation system, accomplish mission viability a assessment and evaluation. | ed for optimal use of available mobility ype, location, and status of DoD transportation tools and technologies to better manage and | | | |
| U) In FY 2005: Begin developing tools and technologies to revolutionize a swiftly and effectively to global demands across all spectrums of operat conflict. Enable the capability to rapidly synchronize theater information mobility forces to support time critical mobility and the seamless interop for air traffic control. Initiate development of advanced reasoning techn development. Explore the use of advanced computer mark-up language mobility ontology to improve automation of the decision support tools f | tions from humanitarian relief to a major on superiority capabilities between combat and perability of DoD, Civil, and Coalition units niques for mobility courses-of-action es and initiate the development of common | | | |
| Project 4872 R-1 Sł | hopping List - Item No. 31-14 of 31-19 | | Exhibit R-2a (| |

| Exhibit R-2a, RDT&E F | Project Justification | | DATE February 2004 | | | |
|--|--|-------------|---|-------|--|--|
| BUDGET ACTIVITY 03 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603789F C3I Advanced Develop | ment 4872 A | JECT NUMBER AND TITLE 2 Aerospace Information ninance | | | |
| and execution management. | | | | | | |
| (U) (U) MAJOR THRUST: Develop and demonstrate publish, subscribe, and aggregate, share, and tailor information products, enabling horizontal communication, computers, intelligence, surveillance, and reconnaissa | integration of Air Force command, control, | 2.575 | 2.357 | 2.793 | | |
| (U) In FY 2003: Developed and demonstrated the techniques to produce Joint Battlespace Infosphere from numerous web-enabled information and to deliver decision-quality information to any warfighter. Develo technologies to dynamically integrate disparate command and control information systems into the Joint Battlespace Infosphere (JBI). Eval management services that enable information exchange among dispar | and manage information objects within the n sources, to customize information products, oped and demonstrated data system wrapper l, intelligence, surveillance, and reconnaissance luated and integrated core JBI information | | | | | |
| (U) In FY 2004: Continue to develop and demonstrate the techniques to r Battlespace Infosphere (JBI), from diverse information sources and da data system wrapper technologies to dynamically integrate disparate a surveillance, and reconnaissance information systems into the JBI. Con information management services to enable information exchange am | manage information objects within the Joint ata environments. Develop and demonstrate and legacy command and control, intelligence, ontinue to evaluate and integrate core JBI | | | | | |
| (U) In FY 2005: Demonstrate the techniques to manage thousands of info sources and data environments within a command and control informat demonstrate information management services that enable information systems. Evaluate and demonstrate technologies that enable the selec multiple security level boundaries. | ormation objects from diverse information ation space. Complete the integration and n exchange among disparate information | | | | | |
| (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonst generation of planning and assessment techniques that enable aerospa operational effects at the right place at the right time. Note: This effor Congressional Add funds for Effects-Based Operations. | ce commanders to determine the desired | 1.931 | 2.738 | 2.505 | | |
| (U) In FY 2003: Demonstrated the effects-based operations capability thr recommended priorities, resource availability, and provide the inform mission objectives. Developed and demonstrated effects-based tools allow the commander and his/her staff to make decisions with uncerta course of an aerospace campaign. Developed a dynamic tasking toolk comprehensive, coherent, and integrated joint aerospace operations pl | ation to the battle managers in time to achieve to operate in the battlespace infosphere that will ain, ambiguous, or vague information during the kit that enables the warfighter to develop a | | | | | |
| (U) In FY 2004: Complete the demonstration of effects-based operational technologies that provide recommended priorities, resource availabilit | l capability, using planning and decision-aid | | | | | |
| | Shopping List - Item No. 31-15 of 31-19 | | Exhibit R-2a (F | | | |

| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DAT | E February | 2004 |
|--------------------------|---|---|--|--|--|--|---------------------|-----------------------------------|-----------------------------------|-------------------|
| | GET ACTIVITY Advanced Technology Develop | ment (ATD) | | | PE NUMBER A 0603789F C | ND TITLE 3I Advanced | Development | | MBER AND TITLE pace Informat | ion |
| | managers in time to achieve mission forces' command and control tools t his/her staff to quickly obtain releva campaign. Develop and complete a comprehensive, coherent, and integi In FY 2005: Initiate design of new assessment by enabling the generati Investigate various capabilities to su in near-real-time, various course of predictive battlespace awareness too shorten the current execution timelit in an AOC. | to operate in the l ant information, a dynamic tasking rated joint aerosp concepts and tec ion, tasking, and upport Aerospace action options ba obs and processes | battlespace info and make timely g process archite bace operations hnologies suppo assessment of e e Operation Cen ased upon comm g. Initiate invest | sphere, which w decisions durin ecture that enable plan, which can orting effects-ba ffects-based Dyn ter (AOC) perse- nander's intent an igation of advan | ill allow the con ag the course of a es the warfighter be dynamically sed planning, ex namic Air Execu onnel in develop nd knowledge ga aced information | nmander and a global aerospa r to develop a executed. ecution, and tion Orders. ving and assessin ained from technologies to | ıg, | | | |
| (U) | Total Cost | | | | | | | 8.680 | 8.424 | 8.390 |
| (U) (U) (U) (U) | C. Other Program Funding Summ Related Activities: PE 0602702F, Command, Control, and Communications This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable. | <u>mary (\$ in Milli</u> <u>FY 2003</u> <u>Actual</u> | <u>ons</u>) <u>FY 2004</u> <u>Estimate</u> | FY 2005 Estimate | FY 2006 Estimate | <u>FY 2007</u> <u>Estimate</u> | FY 2008 Estimate | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| Pro | ject 4872 | | R· | | Item No. 31-16 of | 31-19 | | | Exhibit R-2a (| PE 0603789F) |

| | Ext | nibit R-2a, F | RDT&E Pro | ject Justifi | cation | | | DATE | February | 2004 |
|------------|---|---|---|--|---|--|---|-----------------|------------------|--------------|
| | GET ACTIVITY Advanced Technology Development (. | | | | E NUMBER AND | TITLE Advanced De | | PROJECT NUME | | uperiority |
| 037 | Advanced recimology Development (| FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ in Millions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | Total |
| 492 | 5 Collaborative Info Superiority | 1.779 | 2.247 | 1.880 | 1.897 | 1.932 | 1.964 | 1.996 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | A. Mission Description and Budget Item This project develops and demonstrates te a decision-maker when, where, and how in transfer of large volumes of information of reconfiguration and adaptation of existing B. Accomplishments/Planned Program (MAJOR THRUST: Develop, demonstrate, | chnologies for t t is needed. Tec over existing and operational aer \$ in Millions) | chnologies dev l future Air Fo ospace system | eloped will den rce Information s to support sea | nonstrate advan 1 Superiority sy 1 mless integrate | nced integrated stems. The apped operations. | information ar plication of the <u>FY</u> | chitectures for | the near-real-ti | me |
| | embedded information architecture applica In FY 2003: Developed next generation cc architectures for advanced Air Force enterp and collaborative environments for simulat | ble to manned a ollaborative envi orises. Demons | nd unmanned ronments and trated technolo | vehicles. integrated aero | space informat | ion | | 0.244 | 0.437 | 0.398 |
| (U) | In FY 2004: Develop, demonstrate, and im- maker-to-shooter functions and concepts of automated decision-aiding capability to der facility. Initiate development of airborne p information sources or information sinks (u fielded assets to reduce the timeline of the information mining and collaborative envir | f operations. In ny the enemy th latform capabil- using both on-bo TCT kill chain. | itiate developn e sanctuary of ities to engage pard and off-bo Complete and | nent of a time-c time, for use in in the TCT envo ard resources) demonstrate te | ritical target (7 a command ar vironment eithe to maximize ex | TCT) nd control (C2) er as exploitation of | | | | |
| (U) | | a TCT automate ty to deny the en- this environmen mum exploitation r completing the ter decision mal | ed decision-aid nemy the sanct at either as info on of fielded as e TCT kill chai king for a broad | ling capability f uary of time. Cormation source ssets in accomp n. Initiate deve d range of oper- | Continue develoes or sinks (on- lishing the material the second s | opment of and off-board ximum strike stributive an war | | | | |
| (U) (U) | MAJOR THRUST: Develop communicati capacity. | on technologies | to increase ae | rospace platfor | m information | transfer | | 0.840 | 1.188 | 0.659 |
| Pro | oject 4925 | | R-1 Sho | opping List - Item | No. 31-17 of 31- | 19 | | | Exhibit R-2a (| PE 0603789F) |
| | | | | 470 | | | | | | |

| | Exhibit R-2a, RDT&E Project Jus | tification | | DATE February | 2004 |
|---|--|---|---------|----------------------|--------------|
| | | PE NUMBER AND TITLE | | NUMBER AND TITLE | |
| 03 Advanced Technology | | 0603789F C3I Advanced Development | 4925 60 | bilaborative into Si | uperiority |
| time-critical threat, sensor communication assets. C | echnology to increase aerospace platform information trans r, and C2 information between aircraft and cooperating spa ompleted the design and begin the fabrication of high-capa point and multiple platform connectivity. | ce, airborne, and surface | | | |
| exchange of time-critical space, airborne, and surfa modem technology for po data link capability for mo within the Global Strike T structure that will implem | develop technology to increase aerospace platform informative threat, sensor, and command and control (C2) information ce communication assets. Complete the fabrication of high int-to-point and multiple platform connectivity. Initiate de odernization of aerospace and C2 platforms to support the s Task Force concept. Start investigations of the interface of then a high tempo, weapons on target capability. Begin defi- s-to-weapon platform pairing. | between aircraft and cooperating -capacity, bandwidth efficient, velopment of an initial weapon system-of-systems interoperability weapon systems to the C2 | | | |
| (U) In FY 2005: Complete de capacity exchange of time | evelopment and demonstration of an increased aerospace ple- critical threat, sensor, and C2 information between aircraft on assets. Note: In FY 2005, the development of an initial | t and cooperating space, airborne, | | | |
| (U) MAJOR THRUST: Deve | elop and demonstrate embedded information system techno rapid insertion of battlespace infosphere technology. | logies to support a transparent | 0.695 | 0.602 | 0.623 |
| comprehensive re-test of | echniques for inserting battlespace infosphere technology t the entire C2 system. Developed capability for modernizat em-of-systems interoperability within the battlespace infosp | ion of aerospace and C2 | | | |
| (U) In FY 2004: Complete de comprehensive re-test of t aerospace and C2 platform | evelopment techniques for inserting battlespace infosphere the entire C2 system. Complete the demonstration of capal ns to support system-of-systems interoperability within the d information technology to support command and control | technology that do not require a bility for modernization of battlespace infosphere. Initiate | | | |
| | velopment of embedded information technology to support and autonomous systems. | the Aerospace Operations Center | | | |
| (U) Total Cost | | | 1.779 | 2.247 | 1.880 |
| Project 4925 | | tem No. 31-18 of 31-19 | | Exhibit R-2a (| PE 0603789F) |

| | | Exhibit R- | 2a, RDT&E | Project Ju | | | | | DATE February | 2004 |
|-----|--|---------------------------------|-----------------------------------|---------------------|---------------------------|-----------------------------------|---------------------|------------------------------|------------------|-------------------|
| | GET ACTIVITY Advanced Technology Develop | oment (ATD) | | | PE NUMBER A 0603789F C | | Development | | NUMBER AND TITLE | uperiority |
| (U) | C. Other Program Funding Sum | mary (\$ in Millio | | | | | | | | |
| | | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | FY 2005 Estimate | FY 2006 Estimate | <u>FY 2007</u> <u>Estimate</u> | FY 2008 Estimate | <u>FY 20</u> <u>Estin</u> | | <u>Total Cost</u> |
| (U) | Related Activities: PE 0602702F, Command, Control, and Communications This project has been coordinated through the Reliance process to harmonize | | | | | | | | | |
| (0) | efforts and eliminate duplication. | | | | | | | | | |
| (U) | D. Acquisition Strategy Not Applicable. | | | | | | | | | |
| Pro | ject 4925 | | R· | 1 Shopping List - | Item No. 31-19 of 3 | 31-19 | | | Exhibit R-2a (I | PE 0603789F) |

PE NUMBER: 0603850F PE TITLE: Integrated Broadcast Service (DEM/VAL)

| | Exhib | oit R-2, RDT | &E Budge | t Item Jus | tification | | | C | DATE | February | 2004 |
|---|---|-----------------|----------|-------------|------------------|-----------------|---------------|-----------|---------|----------------|--------|
| | DGET ACTIVITY PE NUMBER AND TITLE Advanced Technology Development (ATD) PE NUMBER AND TITLE 0603850F Integrated Broadcast Service (DE | | | | | | | | | | |
| Cost (\$ in Millions) FY 2003 FY 2004 FY 2005 FY 2006 FY 2007 FY 2003 | | | | | | FY 2008 | FY 200 |)9 | Cost to | Total | |
| | Cost (\$ III Millions) | Estimate | Estimate | Estimate | Estimate | Estima | ite | Complete | | | |
| Total | l Program Element (PE) Cost | 0.000 | 8.464 | 2.294 | 0.000 | 0.000 | 0.000 | 0 | .000 | Continuing | TBD |
| 4778 Integ | grated Broadcast Service | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0 | .000 | 0.000 | 0.000 |
| 5151 Blue | Force Tracking | 0.000 | 8.464 | 2.294 | 0.000 | 0.000 | 0.000 | 0 | .000 | Continuing | TBD |
| | oject Number 635151, Joint Blue et Number 674991, Joint Distribut | | | 3FSA) ACTD, | efforts were tra | nsferred from I | PE0207028F, J | oint Expe | dition | ary Force Expe | riment |
| U) <u>A. Missi</u> | ion Description and Budget Iten | n Justification | | | | | | | | | |

JBFSA ACTD - The Joint Blue Force Situation Awareness (JBFSA) ACTD is a continuation of an ACTD started in 2003. Because the ground forces use different communications and distribution methods to develop the Blue Force ground picture, there are latency and granularity problems in the Blue Force ground picture, resulting in a lack of data interoperability. This ACTD will develop, integrate, and sustain web-enabled Common Operating Picture (COP) capabilities for Blue Force Tracking that will be interoperable with Service systems. All candidate solutions for these capabilities will be tested under this ACTD before migration to the Service for sustainment. The ACTD begins transition and starts Extended User Evaluation (EUE). The ACTD begins work solving coalition and multi-level security issues.

FIOP - The Family of Interoperable Operational Pictures is a program designed to implement web-based technologies into Systems of Record, making their data and thus the Common operational and tactical pictures consistent throughout the Services and at all echelons of Combat Operations. The Joint Requirements Oversight Council (JROC) directed"...provide an all source picture of the Battlespace containing actionable decision quality information through the fusion of existing databases." in JROC Memorandum 156-02. Ultimately, the efforts described will lead to the underpinnings of Network Centric Operational Warfare.

FIOP Joint Blue Force Situational Awareness (JBFSA) - Many DoD systems provide data regarding friendly forces. There is no single system or mission application that provides a totally integrated (i.e. all blue force data) set of data to the warfighter. This task will perform the systems engineering, architecture development and integration activities leading to a secure, web-based blue force data dissemination network service. This task is being led by the Army and is being done in coordination with the Blue Force Tracking and Single Integrated Ground Picture programs and the Joint Blue Force Situational Awareness Advanced Concept Technology Demonstration.

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing systems.

R-1 Shopping List - Item No. 33-1 of 33-5

Exhibit R-2 (PE 0603850F)

| Exhibit R-2, RDT&E B | udget Item Justification | DATE Februa | ary 2004 |
|---|--|----------------|----------------|
| UDGET ACTIVITY 3 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603850F Integrated Broadcast Service | (DEM/VAL) | |
| U) B. Program Change Summary (\$ in Millions) | | | |
| | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| U) Previous President's Budget | | 8.537 | 8.55 |
| U) Current PBR/President's Budget | 0.000 | 8.464 | 2.29 |
| U) Total Adjustments | 0.000 | -0.073 | |
| U) Congressional Program Reductions | | -0.073 | |
| Congressional Rescissions | | | |
| Congressional Increases | | | |
| Reprogrammings | | | |
| SBIR/STTR Transfer | | | |
| U) <u>Significant Program Changes:</u> | | | |
| Not Applicable. | | | |
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R-1 Shopping List - Item No. 33-2 of 33-5

| | ExI | hibit R-2a, | RDT&E Pro | oject Justif | ication | | | DATE | February | 2004 |
|--|---|---|---|--------------------------------------|--|-------------------------------------|-----------------------------------|--|-----------------------------------|-------------------------|
| | ET ACTIVITY dvanced Technology Development (| (ATD) | | 0 | PE NUMBER AND 0603850F Inte Service (DEM | grated Broad | dcast | PROJECT NUMI | BER AND TITLE | st Service |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ in Minions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 4778 | | 0.000 | 0.000 | 0.000 | | 0.000 | 0.000 | | 0.000 | 0.000 |
| | Quantity of RDT&E Articles 03, the Air Force funds this ACTD in the | 0 | 0 | 0 | ŷ | 0 | 0 | 0 | | |
| | A. Mission Description and Budget Iter The Air Force's Blue Force Tracking ACT methods to develop the Blue Force ground This ACTD will develop, integrate, and s systems. All candidate solutions for these | ΓD is a continu d picture, there ustain web-ena | ation of an AC are latency and ble Common C | d granularity pr Operating Pictur | roblems in the E re (COP) capabi | Blue Force grou ilities for Blue | ind picture, res Force Trackin | sulting in a lack g that will be in | of data interop | erability. |
| (U) 4 (U) 1 (U) 7 (U) 1 (U) 1 (U) 2 | B. Accomplishments/Planned Program (Accomplishments/Planned Program No Activity Fraining, Tactics, Procedure (TTP)/CONO Field Tests Spiral 3 software development Fotal Cost | | t | | | | <u>F</u> Y | <u>Y 2003</u> 0.000 0.000 | <u>FY 2004</u> 0.000 | <u>FY 2005</u> 0.000 |
| (U) | C. Other Program Funding Summary (S | \$ in Millions) | | | | | | | | |
| (U) (U) | FY | <u>2003</u> <u>F</u> | | <u>Ey 2005</u> Estimate | <u>FY 2006</u> <u>Estimate</u> | FY 2007 Estimate | <u>FY 2008</u> <u>Estimate</u> | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | <u>Total Cost</u> |
| Proje | ect 4778 | | R-1 S | hopping List - Ite | m No. 33-3 of 33- | 5 | | | Exhibit R-2a (| PE 0603850F) |

| | Evh | nibit R-2a, F | | vioet luctifi | ication | | | Γ | DATE | | |
|--|---|--|---|--|--|---|--|---|--|--|---|
| | | | February | 2004 | | | | | | | |
| | T ACTIVITY vanced Technology Development (| ATD) | | 0 | E NUMBER AND 603850F Inte Service (DEM/ | grated Broad | lcast | | | R AND TITLE Ce Tracking | I |
| | Cost (\$ in Millions) | FY 2003 | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 200 | | Cost to | Total |
| | | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estima | | Complete | |
| 5151 | Blue Force Tracking | 0.000 | 8.464 | 2.294 | 0.000 | 0.000 | 0.000 | | 0.000 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | <u> </u> |
| | 2004, Project Number 635151, Joint Blue | | | BFSA) ACTD, | efforts were tra | ansferred from | PE0207028F, . | Joint Expe | ditiona | ry Force Exp | eriment |
| (JEFX |), Project Number 674991, Joint Distribut | ed Engineering | Plant. | | | | | | | | |
| | in a lack of data interoperability. This AC will be interoperable with Service systems The ACTD begins transition and starts Ex FIOP - The Family of Interoperable Opera the Common operational and tactical pictu | s. All candidate tended User Ev ational Pictures | e solutions for aluation (EUE is a program d | these capabilities). The ACTD | es will be testec begins work sol lement web-bas | d under this AC lving coalition sed technologie | CTD before mig and multi-leve and Systems | gration to | the Serv issues. | vice for susta | inment. |
| | (JROC) directed"provide an all source p Memorandum 156-02. Ultimately, the eff FIOP Joint Blue Force Situational Awarer provides a totally integrated (i.e. all blue f activities leading to a secure, web-based b Force Tracking and Single Integrated Gro | icture of the Ba forts described w ness (JBFSA) - force data) set o lue force data d und Picture pro | attlespace conta will lead to the Many DoD syst f data to the wa lissemination r grams and the | aining actionab underpinnings stems provide d arfighter. This network service Joint Blue Ford | le decision qual of Network Ce lata regarding fi task will perfor . This task is b ce Situational A | lity information entric Operation riendly forces. rm the systems eing led by the wareness Adva | n through the final Warfare. There is no si engineering, a Army and is b anced Concept | usion of ex ngle system rchitecture being done Technolo | m or mi e develo in coor gy Dem | Oversight Co databases." ir ission applica opment and in rdination with | ouncil a JROC ation that attegration |
| | (JROC) directed"provide an all source p Memorandum 156-02. Ultimately, the eff FIOP Joint Blue Force Situational Awarer provides a totally integrated (i.e. all blue f activities leading to a secure, web-based b Force Tracking and Single Integrated Gro This program is in Budget Activity 3, Adv | icture of the Ba forts described w ness (JBFSA) - force data) set o lue force data d und Picture pro vanced Technol | attlespace conta will lead to the Many DoD syst f data to the wa lissemination r grams and the | aining actionab underpinnings stems provide d arfighter. This network service Joint Blue Ford | le decision qual of Network Ce lata regarding fi task will perfor . This task is b ce Situational A | lity information entric Operation riendly forces. rm the systems eing led by the wareness Adva | n through the final Warfare. There is no si engineering, a Army and is b anced Concept | usion of ex ngle system rchitecture being done Technolo sting system | m or mi e develo in coor gy Den ems. | Oversight Co databases." in ission applica opment and in rdination with nonstration. | ouncil n JROC ation that ntegration n the Blue |
| (U) <u>B</u> | (JROC) directed"provide an all source p Memorandum 156-02. Ultimately, the eff FIOP Joint Blue Force Situational Awarer provides a totally integrated (i.e. all blue f activities leading to a secure, web-based b Force Tracking and Single Integrated Gro This program is in Budget Activity 3, Adv Accomplishments/Planned Program (S | icture of the Ba forts described w ness (JBFSA) - force data) set o lue force data d und Picture pro vanced Technol | attlespace conta will lead to the Many DoD syst f data to the wa lissemination r grams and the | aining actionab underpinnings stems provide d arfighter. This network service Joint Blue Ford | le decision qual of Network Ce lata regarding fi task will perfor . This task is b ce Situational A | lity information entric Operation riendly forces. rm the systems eing led by the wareness Adva | n through the final Warfare. There is no si engineering, a Army and is b anced Concept ologies for exi | usion of ex ngle system rchitecture being done Technolo sting system <u>2003</u> | m or mi e develo in coor gy Den ems. | Oversight Co databases." ir ission applica opment and in rdination with nonstration. | Duncil DIROC Attion that Integration In the Blue EY 2005 |
| (U) <u>B</u> (U) A | (JROC) directed"provide an all source p Memorandum 156-02. Ultimately, the eff FIOP Joint Blue Force Situational Awarer provides a totally integrated (i.e. all blue f activities leading to a secure, web-based b Force Tracking and Single Integrated Gro This program is in Budget Activity 3, Adv Accomplishments/Planned Program (f accomplishments Planned Program) | icture of the Ba forts described w ness (JBFSA) - force data) set o lue force data d und Picture pro vanced Technol | attlespace conta will lead to the Many DoD syst f data to the wa lissemination r grams and the | aining actionab underpinnings stems provide d arfighter. This network service Joint Blue Ford | le decision qual of Network Ce lata regarding fi task will perfor . This task is b ce Situational A | lity information entric Operation riendly forces. rm the systems eing led by the wareness Adva | n through the final Warfare. There is no simengineering, a Army and is banced Concept sologies for eximensional statements of the second statement of | usion of ex ngle system rchitecture being done Technolo sting system <u>7 2003</u> 0.000 | m or mi e develo in coor gy Den ems. | Oversight Co databases." in ission applica opment and in rdination with nonstration. | ouncil a JROC ation that ntegration a the Blue |
| (U) <u>B</u> (U) A (U) N | (JROC) directed"provide an all source p Memorandum 156-02. Ultimately, the eff FIOP Joint Blue Force Situational Awarer provides a totally integrated (i.e. all blue f activities leading to a secure, web-based b Force Tracking and Single Integrated Gro This program is in Budget Activity 3, Adv Accomplishments/Planned Program (s accomplishments Planned Program to Activity | icture of the Ba forts described w ness (JBFSA) - force data) set o lue force data d und Picture pro vanced Technol | attlespace conta will lead to the Many DoD syst f data to the wa lissemination r grams and the | aining actionab underpinnings stems provide d arfighter. This network service Joint Blue Ford | le decision qual of Network Ce lata regarding fi task will perfor . This task is b ce Situational A | lity information entric Operation riendly forces. rm the systems eing led by the wareness Adva | n through the final Warfare. There is no simengineering, a Army and is banced Concept sologies for eximensional statements of the second statement of | usion of ex ngle system rchitecture being done Technolo sting system <u>2003</u> | m or mi e develo in coor gy Den ems. | Oversight Co databases." in ission applica opment and in rdination with nonstration. <u>FY 2004</u> 0.000 | buncil a JROC ation that ntegration a the Blue <u>FY 2005</u> 0.000 |
| (U) <u>B</u> (U) A (U) N (U) E | (JROC) directed"provide an all source p Memorandum 156-02. Ultimately, the eff FIOP Joint Blue Force Situational Awarer provides a totally integrated (i.e. all blue f activities leading to a secure, web-based b Force Tracking and Single Integrated Gro This program is in Budget Activity 3, Adv Accomplishments/Planned Program (S accomplishments Planned Program Io Activity ngineering, Integration & Testing | icture of the Ba forts described w ness (JBFSA) - force data) set o lue force data d und Picture pro vanced Technol | attlespace conta will lead to the Many DoD syst f data to the wa lissemination r grams and the | aining actionab underpinnings stems provide d arfighter. This network service Joint Blue Ford | le decision qual of Network Ce lata regarding fi task will perfor . This task is b ce Situational A | lity information entric Operation riendly forces. rm the systems eing led by the wareness Adva | n through the final Warfare. There is no simengineering, a Army and is banced Concept sologies for eximensional statements of the second statement of | usion of ex ngle system rchitecture being done Technolo sting system <u>7 2003</u> 0.000 | m or mi e develo in coor gy Den ems. | Oversight Co databases." ir ission applica opment and in rdination with nonstration. | a JROC ation that ntegration a the Blue <u>FY 2005</u> 0.000 0.920 |
| U) B U) A U) N U) E U) E | (JROC) directed"provide an all source p Memorandum 156-02. Ultimately, the eff FIOP Joint Blue Force Situational Awarer provides a totally integrated (i.e. all blue f activities leading to a secure, web-based b Force Tracking and Single Integrated Gro This program is in Budget Activity 3, Adv Accomplishments/Planned Program (s accomplishments Planned Program to Activity ngineering, Integration & Testing emonstration/Exercise Support | icture of the Ba forts described w ness (JBFSA) - force data) set o lue force data d und Picture pro vanced Technol \$ in Millions) | attlespace conta will lead to the Many DoD sys f data to the wa lissemination r grams and the ogy Developm | aining actionab underpinnings stems provide d arfighter. This network service Joint Blue Ford ent, since it dev | le decision qual of Network Ce lata regarding fi task will perfor . This task is b ce Situational A | lity information entric Operation riendly forces. rm the systems eing led by the wareness Adva | n through the final Warfare. There is no simengineering, a Army and is banced Concept sologies for eximensional statements of the second statement of | usion of ex ngle system rchitecture being done Technolo sting system <u>7 2003</u> 0.000 | m or mi e develo in coor gy Den ems. | Oversight Co databases." in ission applicatory opment and in rdination with nonstration. <u>FY 2004</u> 0.000 1.767 | buncil n JROC ation that ntegration n the Blue <u>FY 2005</u> 0.000 0.920 0.339 |
| (U) <u>B</u> (U) A (U) N (U) E (U) C (U) C | (JROC) directed"provide an all source p Memorandum 156-02. Ultimately, the eff FIOP Joint Blue Force Situational Awarer provides a totally integrated (i.e. all blue f activities leading to a secure, web-based b Force Tracking and Single Integrated Gro This program is in Budget Activity 3, Adv Accomplishments/Planned Program (accomplishments Planned Program (accomplishments Planned Program (Activity ngineering, Integration & Testing Demonstration/Exercise Support CONOPS/Tactics, Techniques, and Proced | icture of the Ba forts described w ness (JBFSA) - force data) set o lue force data d und Picture pro vanced Technol \$ in Millions) ures (TTP) & D | attlespace conta will lead to the Many DoD syst f data to the wa lissemination r grams and the ogy Developm | aining actionab underpinnings stems provide d arfighter. This network service Joint Blue Ford ent, since it dev Development | le decision qual of Network Ce lata regarding fi task will perfor . This task is b ce Situational A velops and dem | lity information intric Operation riendly forces. rm the systems eing led by the wareness Adva ionstrates techn | n through the f nal Warfare. There is no si engineering, a Army and is b anced Concept ologies for exi <u>FY</u> | usion of ex ngle system rchitecture being done Technolo sting system <u>7 2003</u> 0.000 | m or mi e develo in coor gy Den ems. | Oversight Co databases." in ission applicatory opment and in rdination with nonstration. <u>FY 2004</u> 0.000 1.767 0.180 | a JROC ation that ntegration a the Blue <u>FY 2005</u> 0.000 0.920 |
| (U) <u>B</u> (U) A (U) E (U) E (U) C (U) C (U) P | (JROC) directed"provide an all source p Memorandum 156-02. Ultimately, the eff FIOP Joint Blue Force Situational Awarer provides a totally integrated (i.e. all blue f activities leading to a secure, web-based b Force Tracking and Single Integrated Gro This program is in Budget Activity 3, Adv Accomplishments/Planned Program (f Accomplishments Planned Program (f Activity ngineering, Integration & Testing Demonstration/Exercise Support ONOPS/Tactics, Techniques, and Proced urchase/Lease and Installation of BFT De | icture of the Ba forts described w ness (JBFSA) - force data) set o lue force data d und Picture pro vanced Technol \$ in Millions) ures (TTP) & D | attlespace conta will lead to the Many DoD syst f data to the wa lissemination r grams and the ogy Developm | aining actionab underpinnings stems provide d arfighter. This network service Joint Blue Ford ent, since it dev Development | le decision qual of Network Ce lata regarding fi task will perfor . This task is b ce Situational A velops and dem | lity information intric Operation riendly forces. rm the systems eing led by the wareness Adva ionstrates techn | n through the f nal Warfare. There is no si engineering, a Army and is b anced Concept ologies for exi <u>FY</u> | usion of ex ngle system rchitecture being done Technolo sting system <u>7 2003</u> 0.000 | m or mi e develo in coor gy Den ems. | Oversight Co databases." in ission applicatory opment and in rdination with nonstration. <u>FY 2004</u> 0.000 1.767 | buncil a JROC ation that integration in the Blue <u>FY 2005</u> 0.000 0.920 0.339 |
| (U) E (U) A (U) N (U) E (U) C (U) C (U) P | (JROC) directed"provide an all source p Memorandum 156-02. Ultimately, the eff FIOP Joint Blue Force Situational Awarer provides a totally integrated (i.e. all blue f activities leading to a secure, web-based b Force Tracking and Single Integrated Gro This program is in Budget Activity 3, Adv Accomplishments/Planned Program (accomplishments Planned Program (accomplishments Planned Program (Activity ngineering, Integration & Testing Demonstration/Exercise Support CONOPS/Tactics, Techniques, and Proced | icture of the Ba forts described w ness (JBFSA) - force data) set o lue force data d und Picture pro vanced Technol \$ in Millions) ures (TTP) & D | attlespace conta will lead to the Many DoD syst f data to the wa lissemination r grams and the ogy Developm | aining actionab underpinnings stems provide d arfighter. This network service Joint Blue Ford ent, since it dev Development | le decision qual of Network Ce lata regarding fi task will perfor . This task is b ce Situational A velops and dem | lity information intric Operation riendly forces. rm the systems eing led by the wareness Adva ionstrates techn | n through the f nal Warfare. There is no si engineering, a Army and is b anced Concept ologies for exi <u>FY</u> | usion of ex ngle system rchitecture being done Technolo sting system <u>7 2003</u> 0.000 | m or mi e develo in coor gy Den ems. | Oversight Co databases." in ission applicatory opment and in rdination with nonstration. <u>FY 2004</u> 0.000 1.767 0.180 | buncil n JROC ation that ntegration n the Blue <u>FY 2005</u> 0.000 0.920 0.339 |

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| | Exhibit R- | 2a, RDT&E | Project Jus | tification | | | DA | TE February | 2004 | |
|--|--------------------|---------------------|---------------------|---|---------------------|----------------------------|--------------------|-----------------------------------|----------------------|--|
| UDGET ACTIVITY 3 Advanced Technology Develo | opment (ATD) | | | PE NUMBER A 0603850F In Service (DE | tegrated Broa | ndcast | | JMBER AND TITLE Force Tracking | J | |
| U) Transition Support U) SPO Operations U) FIOP Joint Blue Force Situationa enhancements | l Awareness Integr | rated Architectur | e Development | and Interoperabi | lity | | | 0.230 5.787 | 0.57 0.23 0.00 | |
| U) Total Cost | | | | | | | 0.000 | 8.464 | 2.29 | |
| U) <u>C. Other Program Funding Su</u> U) Not Applicable The funding for the FIOP effort the | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | <u>FY 2008</u> Estimate | FY 2009 Estimat | | <u>Total Cos</u> | |
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PE NUMBER: 0603924F PE TITLE: High Energy Laser Advanced Technology Program

| | Exhi | bit R-2, RDT | &E Budge | t Item Just | ification | | | DATE | February | 2004 |
|-------------------------------|--|--|--|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|----------------|
| UDGET ACT | | | - | | E NUMBER AND | TITLE | | | February | 2004 |
| 3 Advance | ed Technology Development | (ATD) | | | | h Energy Las | er Advanced | l Technology | Program | |
| | Cost (\$ in Millions) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | Cost to Complete | Total |
| Tot | al Program Element (PE) Cost | 0.000 | 10.818 | 8.547 | 6.136 | 3.826 | 3.887 | 3.958 | 0.000 | 0.0 |
| 1097 ~ | h Energy Laser Advanced hnology Program | 0.000 | 10.818 | 8.547 | 6.136 | 3.826 | 3.887 | 3.958 | 0.000 | 0.0 |
| | 2004, this program was transferre | d to the Air Forc | e by the Office | of the Secretar | y of Defense. | The Air Force | continues the ti | ri-Service opera | ation of the prop | gram |
| der the Hig | gh Energy Laser (HEL) Joint Tech | nology Office (J | TO). | | | | | | | |
| Service lasers, This pr | under this program are chosen fo e/Agency programs that are direct beam control, optics, propagation rogram is in Budget Activity 3, Ac | ed at more specif , and free electro lvanced Technol | ic Service need n lasers. ogy Developm | ds. A broad ran | ige of technolo | gies are address | sed in key areas | s such as chemi | ical lasers, solic | |
| | pments that have military utility a gram Change Summary (\$ in M | · | ghter needs. | | | | | | | |
| | | | | | | | <u>FY 2003</u> | FY2 | 2004 | <u>FY 2005</u> |
| U) Previou | is President's Budget | | | | | | 0.000 | | .910 | 8.569 |
| J) Curren | t PBR/President's Budget | | | | | | 0.000 | 10 | .818 | 8.547 |
| U) Total A | djustments | | | | | | 0.000 | -0 | .092 | |
| Congre | essional Program Reductions | | | | | | | -0 | .092 | |
| - | essional Increases | | | | | | | | | |
| | rammings | | | | | | | | | |
| | STTR Transfer | | | | | | | | | |
| In FY 2 | <u>cant Program Changes:</u> 2004, this program was transferrec he HEL JTO. | l to the Air Force | by the Office | of the Secretary | y of Defense. | The Air Force c | ontinues the tri | i-Service opera | tion of the prog | ram |
| | | | 5.4.0 | | | - | | | | |

Exhibit R-2 (PE 0603924F)

| BUIDER PACTIVITY 03 Advanced Technology Development (ATD) Cost (\$ in Millions) Actual Estimate Filte F | | E | khibit R-2a, F | RDT&E Pro | ject Justif | ication | | | DATE | February | 2004 |
|---|------------|--|--|--|--|--|---|--|--|--|-----------------------------|
| Cost (s in Millions) Actual Fistimate | | | : (ATD) | | 0 | 603924F Higl | h Energy Las | | 5095 High Er | nergy Laser A | dvanced |
| High Energy Laser Advanced 0.000 10.818 8.547 6.136 3.826 3.887 3.958 0.000 0.000 Quantity of RDT&E Articles 0 <th></th> <th>Cost (\$ in Millions)</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>Total</th> | | Cost (\$ in Millions) | | | | | | | | | Total |
| (I) A. Mission Description and Budget Hem Justification This program funds HEL advanced technology development through the HEL JTO. HEL weapon systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase: defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and the ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall DOD HEL Science and Technology program. In general, efforts funded under this program are drosen for their potential to have major impact on multiple HEL systems and on multiple Service missions while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics, propagation, and free electron lasers. This program is in Budget Activity 3, Advanced Technology Development, since it enables and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs. (I) B. Accomplishments/Planned Program (S in Millions) (I) IPY 2003, this activity was performed under PE 0603924D8Z, High Energy Laser Research. The FY 2003 funding was approximately \$13.6 million. (II) IN FY 2004. Participate in the Join High Power Solid State Laser project to accelerate the demonstration of solid state lasers at initial weapon grade power levels. Continue development of a 25 kilowat solid state laboratory laser. Begin development of a design for a 100 kilowatt laser. Begin assembly of successful pieces from individual applied research projects (e.g., reliable pump diode lasers, diode-laser dive | 509 |) = =: | | | | | | | | | 0.000 |
| This program funds HEL advanced technology development through the HEL JTO. HEL weapon systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-trihip and anti-aircraft missiles; and the ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall DOD HEL Science and Technology program. In general, efforts funded under this program are chosen for their potential to have major impact on multiple HEL systems and on multiple Service missions while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics, propagation, and free electron lasers. This program is in Budget Activity 3, Advanced Technology Development, since it enables and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs. (U) B. Accomplishmets/Planned Program (S in Millions) FY 2003 FY 2004 FY 2005 (U) In FY 2003, this activity was performed under PE 0603924D8Z, High Energy Laser Research. The FY 2003 funding was approximately \$13.6 million. 0.000 5.500 5.500 (U) MAJOR THRUST: Develop solid state lasers that have potential as future high energy laser (HEL) weapon laser 0.000 5.500 5.500 <t< td=""><td></td><td>Quantity of RDT&E Articles</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td></td><td></td></t<> | | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| U B. Accomplishments/Plannet Program (\$ in Millions) FY 2003 FY 2003 FY 2004 FY 2005 (U) In FY 2003, this activity was performed under PE 0603924D8Z, High Energy Laser Research. The FY 2003 funding was approximately \$13.6 million. FY 2003 FY 2004 FY 2005 (U) MAJOR THRUST: Develop solid state lasers that have potential as future high energy laser (HEL) weapon laser 0.000 5.500 5.500 devices because of their inherent small size and the fact that they require only electrical energy in order to run, thereby greatly simplifying systems engineering and supportability. U) In FY 2003: Not Applicable. 5.500 5.500 5.500 (U) In Y2 2004: Participate in the Joint High Power Solid State Laser project to accelerate the demonstration of solid state lasers at initial weapon grade power levels. Continue development of a 25 kilowatt solid state laboratory laser. Begin development of a design for a 100 kilowatt laser. Begin assembly of successful pieces from individual applied research projects (e.g., reliable pump diode lasers, diode-laser drivers, thin-disk amplifiers, phase-conjugate mirrors, mist cooling) into an advanced demonstration of solid state laser sub-systems scalable to weapon power levels. U) In FY 2005: Participate in the Joint High Power Solid State Laser project to demonstrate a 25 kilowatt laser. Continue development of a design for a 100 kilowatt laser. Factors such as performance, cost, etc. will be evaluated between the various approaches funded by the Army, Air Force, and High Energy Laser Joint Technology Office. Continue to assemble | | military missions including interception negation of targets in urban environmen funded under this program are chosen for Service/Agency programs that are direct lasers, beam control, optics, propagation This program is in Budget Activity 3, A | of ballistic missi ts with no collate or their potential t ted at more specif n, and free electro dvanced Technol | les in boost pha ral damage. T o have major i ic Service need n lasers. ogy Developm | ase; defeat of h his program is mpact on multi ds. A broad ran | igh-speed, man part of an overa ple HEL systen nge of technolo | euvering anti-s all DOD HEL S ns and on multi gies are addres | hip and anti-a ccience and Te ple Service m sed in key area | ircraft missiles; echnology progra issions while co as such as chem | and the ultra-pr am. In general, mplementing ical lasers, solid | ecision efforts state |
| MAJOR THRUST: Develop solid state lasers that have potential as future high energy laser (HEL) weapon laser 0.000 5.500 5.500 devices because of their inherent small size and the fact that they require only electrical energy in order to run, thereby greatly simplifying systems engineering and supportability. In FY 2003: Not Applicable. In FY 2004: Participate in the Joint High Power Solid State Laser project to accelerate the demonstration of solid state lasers at initial weapon grade power levels. Continue development of a 25 kilowatt solid state laboratory laser. Begin development of a design for a 100 kilowatt laser. Begin assembly of successful pieces from individual applied research projects (e.g., reliable pump diode lasers, diode-laser drivers, thin-disk amplifiers, phase-conjugate mirrors, mist cooling) into an advanced demonstration of solid state laser sub-systems scalable to weapon power levels. In FY 2005: Participate in the Joint High Power Solid State Laser project to demonstrate a 25 kilowatt laser. Continue development of a design for a 100 kilowatt laser. Factors such as performance, cost, etc. will be evaluated between the various approaches funded by the Army, Air Force, and High Energy Laser Joint Technology Office. Continue to assemble successful pieces from individual applied research projects (e.g., reliable pump diode lasers, Project 5095 R-1 Shopping List - Item No. 34-3 of 34-6 | (U) | B. Accomplishments/Planned Program In FY 2003, this activity was performed a | n (\$ in Millions) | - | nergy Laser Res | search. The FY | 2003 funding | FY | <u>¥ 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> |
| | (U) (U) | devices because of their inherent small si greatly simplifying systems engineering a In FY 2003: Not Applicable. In FY 2004: Participate in the Joint High state lasers at initial weapon grade power Begin development of a design for a 100 research projects (e.g., reliable pump dio mist cooling) into an advanced demonstra In FY 2005: Participate in the Joint High Continue development of a design for a 1 between the various approaches funded b | ze and the fact th and supportability Power Solid Stat levels. Continue kilowatt laser. B de lasers, diode-la ation of solid stat Power Solid Stat 00 kilowatt laser by the Army, Air I | at they require 2. e Laser project e development egin assembly user drivers, this e laser sub-syste e Laser project . Factors such Force, and Hig | only electrical t to accelerate t of a 25 kilowat of successful p in-disk amplifie tems scalable to t to demonstrate as performance h Energy Laser | energy in order he demonstration t solid state lab bieces from indi ers, phase-conju o weapon powe e a 25 kilowatt e, cost, etc. will r Joint Technolo | on of solid oratory laser. vidual applied agate mirrors, r levels. laser. be evaluated ogy Office. | 7 | 0.000 | | |
| | Pro | ject 5095 | | R-1 Sł | | | 6 | | | Exhibit R-2a (P | PE 0603924F) |

| | TE February | 2004 | | | | |
|---|--|--|-----------|--------------------|--------------|--|
| BUDGET ACTIVITY 03 Advanced Technology Deve | elopment (ATD) | PE NUMBER AND TITLE 0603924F High Energy Laser Advanced Technology Program | 5095 High | T NUMBER AND TITLE | | |
| | mplifiers, phase-conjugate mirrors, mist co | ooling) into an advanced demonstration of | | | | |
| solid state laser sub-systems. (U) | | | | | | |
| | eam-control technologies for surface, air, | and space mission areas, as well as develop | 0.000 | 2.718 | 1.447 | |
| (U) In FY 2003: Not Applicable. | | | | | | |
| (U) In FY 2004: Using successful p | pieces from individual applied research particular compensation algorithms) begin to devel | rojects (e.g., deformable mirrors, wavefront op a fieldable, sub-scale tactical | | | | |
| (U) In FY 2005: Using successful p | pieces from individual applied research pa acking and compensation algorithms; con | rojects; such as deformable mirrors, tinue to develop a fieldable, sub-scale tactical | 0.000 | 0.800 | 0.800 | |
| (U) | | | | | | |
| | ree electron laser (FEL) technologies that | scale to high power and permit FELs to be | | | | |
| fielded on military platforms. | | | | | | |
| (U) In FY 2003: Not Applicable. | | | | | | |
| ship). | | can be operated on a military platform (e.g., a | | | | |
| (e.g., a ship). | ng and planning tests of a scalable FEL th | at can be operated on a military platform | | | | |
| (U) | | | | 4 9 9 9 | | |
| more supportable chemical lase | • | concepts that allow higher performance and | 0.000 | 1.800 | 0.800 | |
| (U) In FY 2003: Not Applicable. | | | | | | |
| (U) In FY 2004: Begin development realistic capability to regenerate | nt of an integrated closed-cycle chemical | laser device of high power, to include | | | | |
| 1 7 0 | ntegrated closed-cycle chemical laser devi | ice of high power to include realistic | | | | |
| capability to regenerate spent la | | ter angle power, to merado roundue | | | | |
| (U) Total Cost | | | 0.000 | 10.818 | 8.547 | |
| | | | | | | |
| Project 5095 | R-1 S | hopping List - Item No. 34-4 of 34-6 | | Exhibit R-2a (F | PE 0603924F) | |

| | | | | UNCE | ASSIFIED | | | I | | |
|--------------|---|---------------------------------|-----------------------------------|-----------------------------------|----------------------|---------------------|----------------------------|-----------------------------------|-----------------------------------|--------------|
| | | Exhibit R- | 2a, RDT&E | Project Jus | stification | | | DATE | February | 2004 |
| | JDGET ACTIVITY PE NUMBER AND TITLE PROJECT 8 Advanced Technology Development (ATD) 0603924F High Energy Laser 5095 High Advanced Technology Program Technology Program Technology Program | | | | | | | | | Advanced |
| (U) | C. Other Program Funding Sum | <u>mary (\$ in Milli</u> | <u>ons)</u> | | | | | | | |
| | | <u>FY 2003</u> <u>Actual</u> | <u>FY 2004</u> <u>Estimate</u> | <u>FY 2005</u> <u>Estimate</u> | FY 2006 Estimate | FY 2007 Estimate | <u>FY 2008</u> Estimate | <u>FY 2009</u> <u>Estimate</u> | <u>Cost to</u> <u>Complete</u> | Total Cost |
| I I) | PE 0602500F, | | | | | | | | | |
| U) | Multi-Disciplinary Space Technology. | | | | | | | | | |
| U) | PE 0602890F, High Energy Laser Research. | | | | | | | | | |
| T T) | PE 0603444F, Maui Space | | | | | | | | | |
| U) | Surveillance System. PE 0603500F, | | | | | | | | | |
| U) | Multi-Disciplinary Advanced Development Space | | | | | | | | | |
| | Technology. | | | | | | | | | |
| U) | PE 0603605F, Advanced | | | | | | | | | |
| U) | Weapons Technology. PE 0601108F, High Energy Laser Research Initiatives. | | | | | | | | | |
| J) | PE 0603883C, Ballistic Missile Defense Boost Phase Segment. | | | | | | | | | |
| U) | PE 0602605F, Directed Energy Technology. | | | | | | | | | |
| J) | PE 0602307A, Advanced Weapons Technology. | | | | | | | | | |
| U) | PE 0602114N, Power Projection Applied Research. This project has been | | | | | | | | | |
| U) | coordinated through the Reliance process to harmonize efforts and eliminate duplication. | | | | | | | | | |
| (U) | D. Acquisition Strategy | | | | | | | | | |
| | ject 5095 | | F | R-1 Shopping List | - Item No. 34-5 of 3 | 34-6 | | | Exhibit R-2a (| PF 0603924F |
| 110 | | | 1 | | 482 | 54-0 | | | Exhibit R-2a (| I L 00039241 |

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|---|--|----------|--|
| | E Project Justification | | February 2004 |
| BUDGET ACTIVITY 3 Advanced Technology Development (ATD) | PE NUMBER AND TITLE 0603924F High Energy Laser Advanced Technology Program | 5095 Hig | NUMBER AND TITLE h Energy Laser Advanced ogy Program |
| Not Applicable. | | • | |
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| Project 5095 | R-1 Shopping List - Item No. 34-6 of 34-6 | | Exhibit R-2a (PE 0603924 |

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PE NUMBER: 0804757F PE TITLE: JOINT NATIONAL TRAINING CENTER

| Tot 5124 Tra 5124 Tra 10 FY04 847 (U) A. Mi Suppo into a founda This p Natior (U) B. Pro (U) Previo (U) Currer | Cost (\$ in Millions) Cost (PE) Cost raining Transformation 757F, Joint National Training Cap (Ission Description and Budget It orts the SECDEF's Transformation a seamless joint training environmed dation supporting all JNTC operation program is in budget activity 3 - A onal Training Capability. Cogram Change Summary (\$ in M | FY 2003 Actual 0.000 ability, was a new em Justification in Training/Joint nt. Using a scien ons. | National Train tific and phased | FY 2005 Estimate 2.939 2.939 ed new start eff ning Capability d approach, rese | FY 2006 Estimate 2.908 2.908 Forts. (JNTC). Development for the second s | FY 2007 Estimate 3.003 3.003 | FY 2008 Estimate 2.997 2.997 s that integrate methods that pr | FY 2009 Estimate 3.085 3.085 | l technology-ba | |
|---|---|--|--|--|---|--|--|--|--|----------|
| 5124 Tra n FY04 847 U) <u>A. Mi</u> Suppo into a founda This p Natior U) <u>B. Pro</u> U) Previo U) Currer | otal Program Element (PE) Cost raining Transformation 757F, Joint National Training Cap Lission Description and Budget It orts the SECDEF's Transformation a seamless joint training environme dation supporting all JNTC operation program is in budget activity 3 - A onal Training Capability. | Actual 0.000 0.000 ability, was a new em Justification in Training/Joint nt. Using a scien ons. | Estimate 2.915 2.915 PE and include National Train tific and phased | Estimate 2.939 2.939 ed new start eff ning Capability d approach, reso | Estimate 2.908 2.908 Forts. (JNTC). Devel earches new tec | Estimate 3.003 3.003 | Estimate 2.997 2.997 s that integrate methods that pr | Estimate 3.085 3.085 live, virtual, a ovide a crucia | Complete Continuing Continuing nd constructive l technology-ba | TB TB |
| 5124 Tra n FY04 847 U) <u>A. Mi</u> Suppo into a founda This p Natior U) <u>B. Pro</u> U) Previo U) Currer | raining Transformation 757F, Joint National Training Cap Eastion Description and Budget It orts the SECDEF's Transformation a seamless joint training environmed dation supporting all JNTC operation program is in budget activity 3 - A onal Training Capability. | 0.000 0.000 ability, was a new em Justification in Training/Joint nt. Using a scien ons. | 2.915 2.915 PE and includ National Train tific and phased | 2.939 2.939 ed new start eff ning Capability d approach, reso | 2.908 2.908 Forts. (JNTC). Devel earches new tec | 3.003 3.003 | 2.997 2.997 s that integrate methods that pr | 3.085 3.085 live, virtual, a ovide a crucia | Continuing Continuing nd constructive l technology-ba | TB |
| 5124 Tra n FY04 847 U) <u>A. Mi</u> Suppo into a founda This p Natior U) <u>B. Pro</u> U) Previo U) Currer | raining Transformation 757F, Joint National Training Cap Eastion Description and Budget It orts the SECDEF's Transformation a seamless joint training environmed dation supporting all JNTC operation program is in budget activity 3 - A onal Training Capability. | 0.000 ability, was a new em Justification in Training/Joint nt. Using a scien ons. | 2.915 PE and includ National Train tific and phased | 2.939 ed new start eff ning Capability d approach, reso | 2.908 Forts. (JNTC). Deve earches new tec | 3.003 lops capabilities chnologies and r | 2.997 s that integrate methods that pr | 3.085 live, virtual, a ovide a crucia | Continuing Constructive I technology-ba | TB |
| I) <u>A. Mi</u> Suppo into a founda This p Natior U) <u>B. Pro</u> U) Previo U) Currer | 757F, Joint National Training Cap Lission Description and Budget It orts the SECDEF's Transformation a seamless joint training environme dation supporting all JNTC operation program is in budget activity 3 - A onal Training Capability. | ability, was a new em Justification in Training/Joint nt. Using a scien ons. | PE and include National Train tific and phased | ed new start eff ning Capability d approach, reso | forts. (JNTC). Deve earches new tec | lops capabilities | s that integrate methods that pr | live, virtual, a ovide a crucia | nd constructive l technology-ba | elements |
| U) <u>B. Pro</u> J) Previo J) Currer | onal Training Capability. | dvanced Technolo | ogy Demonstra | tion because it | supports rapid t | transformation of | of Department | of Dofores trai | | |
| J) Previo J) Currer | ogram (banga Summary (S in A | | | | | | n Department | or Defense tra | ining into a Join | t |
| U) Currer | ogram Change Summary (\$ m N | <u>11110ns)</u> | | | | I | FY 2003 | FY 2 | 2004 | FY 2005 |
| J) Currer | ous President's Budget | | | | | - | 0.000 | | .940 | 2.947 |
| D Total | ent PBR/President's Budget | | | | | | 0.000 | 2 | .915 | 2.939 |
|) 10tal 1 | Adjustments | | | | | | 0.000 | -0 | .025 | |
| J) Congr | ressional Program Reductions | | | | | | 0.000 | | | |
| Congr | ressional Rescissions | | | | | | 0.000 | -0 | .025 | |
| - | ressional Increases | | | | | | 0.000 | | | |
| | ogrammings | | | | | | 0.000 | | | |
| | /STTR Transfer | | | | | | 0.000 | | | |
| U) <u>Signif</u> | ficant Program Changes: | | | | | | | | | |

R-1 Shopping List - Item No. 37-2 of 37-3

| | | Exhibit R-2 | a, RDT&E P | roject Just | ification | | | DATE | February | 2004 |
|------------|--|---|-------------------------------------|-----------------|--|-----------------|-----------------|---------------------------------|----------------------------------|----------------------------------|
| | GET ACTIVITY Advanced Technology Developn | nent (ATD) | | | PE NUMBER AND 0804757F JOI TRAINING CE | INT NATIONA | ۱L | PROJECT NUM 5124 Trainin | BER AND TITLE g Transforma | ation |
| | Cost (\$ in Millions) | FY 200 | 3 FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | Cost to | Total |
| | Cost (\$ III Millions) | Actual | Estimate | Estimate | Estimate | Estimate | Estimate | Estimate | Complete | |
| 512 | 0 | 0.0 | 2.91 | | | | 2.997 | | Continuing | TBD |
| | Quantity of RDT&E Articles | | 0 | 0 | 0 0 | 0 | 0 | 0 | | |
| (U) | A. Mission Description and Budg Supports the SECDEF's Transformation a seamless joint training environ foundation supporting all JNTC operative sector of the sector of th | ation in Training/ nment. Using a serations. | Joint National Trace | ased approach, | researches new te | echnologies and | l methods that | provide a cruci | al technology-t | based |
| (U) (U) | B. Accomplishments/Planned Prog Begin Close Combat Tactical Traine Begin/Continue Air Force Modeling Upgrades | r Upgrades for Ta and Simulation T | actical Air Contr Tool Kit (AFMS | • | , U | VSIM) | <u>F</u> | <u>Y 2003</u> 0.000 0.000 | <u>FY 2004</u> 0.840 0.865 | <u>FY 2005</u> 0.000 0.875 |
| (U) | Begin/Continue Test & Evaluation N | | . , | | | | | 0.000 | 0.500 | 0.875 |
| (U) | Begin Tactical Air Data Info Link (' | | (J Fix) | | | | | 0.000 | 0.023 | 0.000 |
| (U) | Begin High Level Architecture (HLA | | | | | | | 0.000 | 0.040 | 0.000 |
| | Begin TADIL - J Link-16 Capability | | · · · · · · | | | | | 0.000 | 0.182 | 0.000 |
| | Begin/Continue Theater Battle Mana | • | • | | 1 1 | 1 / . 66 | | 0.000 | 0.227 | 0.939 |
| (U) | Begin/Continue basic operating supp Total Cost | ort, system acqui | sition, engineeri | ng support and | development stud | ales/efforts | | 0.000 | 0.238 | 0.250 2.939 |
| (0) | Total Cost | | | | | | | 0.000 | 2.915 | 2.939 |
| (U) | C. Other Program Funding Sumn | <u>nary (\$ in Million</u> | <u>15)</u> | | | | | | | |
| | | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | FY 2006 | <u>FY 2007</u> | FY 2008 | <u>FY 2009</u> | Cost to | Total Cost |
| | | <u>Actual</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Estimate</u> | <u>Complete</u> | <u>10tar Cost</u> |
| (U) | Related Activities: | | | | | | | | | |
| (U) | PE 0604735F, Combat Training Ranges | 15.244 | 24.077 | 18.714 | 17.490 | 17.935 | 18.454 | 18.732 | Continuing | TBD |
| (U) | PE 0207429F, Combat Training Range Equipment | 49.834 | 94.329 | 32.189 | 34.667 | 35.564 | 37.109 | 37.772 | Continuing | TBD |
| (U) | D. Acquisition Strategy | | | | | | | | | |
| | The acquisition strategy will be con | npetitive, with cos | - | - | | | | | | |
| Pro | ject 5124 | | R-1 | | tem No. 37-3 of 37- | -3 | | | Exhibit R-2a | PE 0804757F) |
| | | | | 4 | 86 | | | | | |