UNCLASSIFIED

DEPARTMENT OF THE AIR FORCE

FISCAL YEAR 2003 PRESIDENT'S BUDGET

RESEARCH, DEVELOPMENT, TEST AND EVALUATION

DESCRIPTIVE SUMMARIES



FEBRUARY 2002

VOLUME I

BUDGET ACTIVITY 1-3

UNCLASSIFIED

UNCLASSIFIED

Fiscal Year 2003 President's Budget RDT&E Descriptive Summaries, Volume I February 2002

INTRODUCTION AND EXPLANATION OF CONTENTS

1. (U) GENERAL 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 2003 President's Budget. All formats in this document are in accordance with the guidelines of the DoD 7000.14R, Financial Management Regulation, Volume 2B, Chapter 5, with the exception of the R-3 exhibit. The USAF could not support the new format matrix because our programs do not track their programs in the manner required to complete the exhibit.

- a. Contents: Exhibits R-2, R-2a and R-3 provide narrative information for all RDT&E program elements and projects within the USAF FY 2003 RDT&E program except the classified program elements. The formats and contents of this document are in accordance with the guidelines and requirement 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. The Justification book has been assembled in accordance with DoD 7000.14R, Financial Management Regulation, Volume 2B, Chapter 5, Section 050402 with the exception of the R-1, Project Funding Listing which was distributed under a separate cover due to classification.

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.

UNCLASSIFIED

PROGRAM ELEMENT (by BUDGET ACTIVITY)	REMARKS
BUDGET ACTIVITY #1: BASIC RESEARCH (Volume I)	
	N/A
BUDGET ACTIVITY 2: APPLIED RESEARCH (Volume I)	
0602102F Materials	In FY 2003, Project 4347, Materials for Structures, Propulsion and Subsystems, were transferred to PE 0602500F, Project 5025, Space Materials Development, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
	In FY 2003, Project 4348, Materials for Electronics, Optics and Surveillance, efforts were transferred to PE 0602500F, Project 5025, Space Materials Development, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
	In FY 2003, Project 5015, Rocket Materials Technology, efforts were transferred to PE 0602500F, Project 5025, Space Materials Development, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
	In FY 2003, Project 4349, Materials Technology for Sustainment, efforts were transferred to PE 0602500F, Multi-Disciplinary Space Technology, Project 5025, Space Materials Development, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
	In FY 2003, Project 5015, Rocket Materials Technology, efforts were transferred from PE 0602203F, Aerospace Propulsion, Project 4847, Rocket Propulsion Technology.
0602201F Aerospace Flight Dynamics	In FY 2003, Project 2403, Flight Control and Vehicle-Pilot Interface, efforts were transferred to PE 0602500F, Multi-Disciplinary Space Technology, Project 5030, Applied Space Access Vehicle Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities
0602202F Human Effectiveness Applied Research	In FY 2003, Project 7184, Crew System Interface and Biodynamics, efforts were transferred to Project 7757, Bioeffects and Protection, to align resources with the Air Force Research Laboratory organization.

PROGRAM ELEMENT (by BUDGET ACTIVITY)	REMARKS
	In FY 2003, Project 7757, Bioeffects and Protection, efforts were transferred from Project 7184, Crew System Interface and Biodynamics, to align resources with the Air Force Research Laboratory organization.
	In FY 2003, Project 7184, Crew System Interface and Biodynamics, efforts were transferred to PE 0602500F, Multi-Disciplinary Space Technology, Project 5024, Human Centered Applied Space Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
0602203F Aerospace Propulsion	In FY 2003, Project 3012, Advanced Propulsion Technology, efforts were transferred to PE 0602500F, Multi-Disciplinary Space Technology, Project 5025, Space Materials Development, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
	In FY 2003, Project 4847, Rocket Propulsion Technology, efforts were transferred to PE 0602102F, Materials, Project 5015, Rocket Materials Technology.
	In FY 2003, Project 4847, Rocket Propulsion Technology, efforts were transferred to PE 0602500F, Multi-Disciplinary Space Technology, Project 5026, Rocket Propulsion Component Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
0602204F Aerospace Sensors	In FY 2003, Project 2002, Electronic Component Technology, efforts were transferred to PE 0602500F, Multi-Disciplinary Space Technology, Projects 5028, Space Sensors, Photonics and RF Processes, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
	In FY 2003, Project 2002, Electronic Component Technology, efforts were transferred to PE 0602500F, Multi-Disciplinary Space Technology, Projects 5029, Space Sensor and Countermeasure Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
	In FY 2003, Project 6095, Sensor Fusion Technology, efforts were transferred to PE 0602500F, Multi-Disciplinary Space Technology, Projects 5028, Space Sensors, Photonics and RF Processes, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

INTRODUCTION AND EXPLANATION OF CONTENTS

PROGRAM ELEMENT (by BUDGET ACTIVITY)

REMARKS

In FY 2003, Project 6095, Sensor Fusion Technology, were transferred to PE 0602500F, Multi-Disciplinary Space Technology, Project 5029, Space Sensor and Countermeasure Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 7622, RF Sensors and Countermeasures Technology, efforts were transferred to PE 0602500F, Multi-Disciplinary Space Technology, Project 5029, Space Sensors and Countermeasures Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 2002, Electronic Component Technology, efforts were transferred to Project 5016, Photonic Component Technology.

In FY 2003, Project 5016, Photonic Component Technology, efforts were transferred from Project 2002, Electronic Component Technology.

In FY 2003, Project 7622, RF Sensors and Countermeasure Technology, efforts were transferred to Project 5017, RF Processing for ISR Sensors.

In FY 2003, Project 5017, RF Processing for ISR Sensors, efforts were transferred from Project 7622, RF Sensors and Countermeasures Technology.

INTRODUCTION AND EXPLANATION OF CONTENTS

PROGRAM ELEMENT (by BUDGET ACTIVITY)

0602500F Multi-Disciplinary Space Technology

REMARKS

In FY 2003, this is a new PE.

In FY 2003, Project 5023, Laser & Imaging Space Technology, efforts were transferred from PE 0602605F, Directed Energy Technology, Project 4866, Laser & Imaging Technology, in conjunction with the Space Commission recommendation to consolidate space unique activities.

In FY 2003, Project 5024, efforts were transferred from PE 0602202F, Human Effectiveness Applied Research, Project 7184, Crew System Interface and Biodynamics, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5025, Space Materials Development, efforts were transferred from PE 0602102F, Materials, Project 4347, Materials for Structures, Propulsion and Subsystems, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5025, Space Materials Development, efforts were transferred from PE 0602102F, Materials, Project 4348, Materials for Electronics, Optics and Surveillance, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5025, Space Materials Development, efforts were transferred from PE 0602102F, Materials, Project 4349, Materials Technology for Sustainment, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5025, Space Materials Development, efforts were transferred from PE 0602102F, Materials, Project 5015, Rocket Materials Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5026, Rocket Propulsion Component Technology, efforts were transferred from PE 0602203F, Aerospace Propulsion, Project 4847, Rocket Propulsion Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

INTRODUCTION AND EXPLANATION OF CONTENTS

PROGRAM ELEMENT (by BUDGET ACTIVITY)

REMARKS

In FY 2003, Project 5027, High Speed Airbreathing Propulsion Technology, efforts were transferred from PE 0602203F, Aerospace Propulsion, Project 3012, Advanced Propulsion Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5028, Space Sensors, Photonics and RF Processes, efforts were transferred from PE 0602204F, Aerospace Sensors, Project 2002, Electronic Component Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5029, Space Sensor and Countermeasure Technology, efforts were transferred from PE 0602204F, Aerospace Sensors, Project 2002, Electronic Component Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5029, Space Sensor and Countermeasure Technology, efforts were transferred from PE 0602204F, Aerospace Sensors, Project 6095 Sensor Fusion Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5029, Space Sensor and Countermeasure Technology, efforts were transferred from PE 0602204F, Aerospace Sensors, Project 7622, RF Sensors and Countermeasures Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5030, Applied Space Access Vehicle Technology, efforts were transferred from PE 0602201F, Aerospace Vehicle Technologies, Project 2403, Flight Control/Vehicle-Pilot Interface, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 1010, Space Survivability & Surveillance, efforts were transferred to Project 5018, Spacecraft Protection Technology.

In FY 2003, Project 5018, Spacecraft Protection Technology, efforts were transferred from Project 1010, Space Survivability & Surveillance.

0602601F Space Technology

PROGRAM ELEMENT (by BUDGET ACTIVITY)	REMARKS
0602605F Directed Energy Technology	In FY 2003, Project 4866, Laser & Imaging Technology, efforts were transferred to PE 0602500F, Multi-Disciplinary Space Technology, Project 5023, Laser & Imaging Space Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
BUDGET ACTIVITY #3: ADVANCED TECHNOLOGY DEVELO	OPMENT (Volume I)
0603112F Adv Materials For Weapon Sys	In FY 2003, Project 2100, Laser Hardened Materials, efforts were transferred to PE 0603500F, Multi-Disciplinary Advanced Development Space Technology, Project 5032, Advanced Space Materials, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
	In FY 2003, Project 3946, Materials Transition, efforts were transferred to PE 0603500F, Multi- Disciplinary Advanced Development Space Technology, Project 5032, Advanced Space Materials, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
0603203F Advanced Aerospace Sensors	In FY 2003, Project 69DF, Target Attack and Recognition Technology, efforts were transferred to Project 5019, Advanced RF Technology for ISR Sensors, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
	In FY 2003, Project 665A, Advanced Aerospace Sensors Technology, efforts were transferred to PE 0603500F, Multi-Disciplinary Advanced Development Space Technology, Project 5034, Advanced Space Sensors, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
	In FY 2003, Projects 665A, Advanced Aerospace Sensors Technology, were transferred to Project 5019, Advanced RF Technology for ISR Sensors, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
0603216F Aerospace Prop and Power Technology	In FY 2003, Project 4922, Space and Missile Rocket Propulsion, efforts were transferred to PE 0603500F, Multi-Disciplinary Advanced Development Space Technologies, Project 5033, Rocket Propulsion Demonstration, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

PROGRAM ELEMENT (by BUDGET ACTIVITY)	REMARKS
0603270F Electronic Combat Technology	In FY 2003, Project 431G, RF Warning and Countermeasures Technology, efforts were transferred to PE 0603500F, Multi-Disciplinary Advanced Development Space Technology, Project 5034, Advanced Space Sensors, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
	In FY 2003, Project 691X, EO/IR Warning and Countermeasures Technology, efforts were transferred to PE 0603500F, Multi-Disciplinary Advanced Development Space Technology, Project 5034, Advanced Space Sensors, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
0603231F Crew System and Personnel Protection Technology	In FY 2003, Project 3257, Helmet-Mounted Sensory Technology, efforts were transferred to Project 5020, Directed Energy Protective Systems, in order to align resources with the Air Force Research Laboratory organization.
	In Fy 2003, Project 5020, Directed Energy Protective Systems, efforts were transferred from Project 3257, Helmet-Mounted Sensory Technology, in order to align resources within the Air Force Research Laboratory organization.
0603401F Advanced Spacecraft Technology	In FY 2003, Project 4400, Space Systems Protection, efforts were transferred from Project 5021, Space Systems Survivability, due to a realignment of work within the project.
	In FY 2003, Project 5021, Space Systems Survivability, efforts were transferred to Project 4400, Space Systems Protection, due to a realignment of work within the project.
0603500F Multi-Disciplinary Advanced Development Space Technology	In FY 2003, this is a new PE.
	In FY 2003, Project 5031, Advanced Optics and Laser Space Technology, efforts were transferred from PE 0603605F, Advanced weapons Technology, Project 3150, Advanced Optics Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
	In FY 2003, Project 5031, Advanced Optics and Laser Space Technology, efforts were transferred from PE 0603605F, Advanced Weapons Technology, Project 3647, Hi Energy Laser Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

INTRODUCTION AND EXPLANATION OF CONTENTS

PROGRAM ELEMENT (by BUDGET ACTIVITY)

REMARKS

In FY 2003, Project 5032, Advanced Space Materials, efforts were transferred from PE 0603112F, Advanced Materials for Weapon Systems, Project 2100, Laser Hardened Materials, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5032, Advanced Space Materials, efforts were transferred from PE 0603112F, Advanced Materials for Weapon Systems, Project 3946, Materials Transition, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5033, Rocket Propulsion Demonstration, efforts were transferred from PE 0603216F, Aerospace Propulsion and Power Technology, Project 4922, Space and Missile Rocket Propulsion, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5034, Advanced Space Sensors, efforts were transferred from PE 0603203F, Advanced Aerospace Sensors, Project 665A, Advanced Aerospace Sensors Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5034, Advanced Space Sensors, efforts were transferred from PE 0603270F, Projects 691X, EO/IR Warning and Countermeasures Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, Project 5034, Advanced Space Sensors, efforts were transferred from PE 0603270, Electronic Combat Technology, Projects 431G, RF Warning and Countermeasures, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

0603605F Advanced Weapons Technology

In FY 2003, Project 3150, Advanced Optics Technology, efforts were transferred to PE 0603500F, Multi-Disciplinary Advanced Development Space Technology, Project 5031, Advanced Optics and Laser Space Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

PROGRAM ELEMENT (by BUDGET ACTIVITY)	REMARKS
	In FY 2003, Project 3647, Hi Energy Laser Technology, were transferred to PE 0603500F, Multi- Disciplinary Advanced Development Space Technology, Project 5031, Advanced Optics and Laser Space Technology, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
BUDGET ACTIVITY #4: DEMONSTRATION AND VALIDATION	N (DEM/VAL) (Volume II)
0603438F Space Control Technology	In FY 2003, Project 2611, Technology Insertion Plan & Analysis, efforts were transferred to PE 0604421F, Counterspace Systems, Project A001, Counter Satellite Communications System, in order to perform Engineering and Manufacturing Development activities.
	In FY 2003, Project 2611, Technology Insertion Plan & Analysis, efforts were transferred to PE 0604421F, Counterspace Systems, Project A002, Counter Surveillance Reconnaissance System, in order to perform Engineering and Manufacturing Development activities.
	In FY 2003, Project 2611, Technology Insertion Plan & Analysis, efforts were transferred to PE 0604421F, Counterspace Systems, Project A003, Rapid Identification Detection and Reporting System, in order to perform Engineering and Manufacturing Development activities.
0603845F Advanced Wideband System (AWS)	In FY 2003, Project 4944, Advanced Wideband System, includes new start efforts.
0603790F NATO Cooperative R&D	In FY 2003, Project 64NATO, NATO Cooperative R&D, efforts were transferred to PE 0603791F, International Space Cooperative R&D, Project 5035, International Space Cooperative R&D, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
0603791F International Space Cooperative R&D	In FY 2003, this is a new PE.
	In FY 2003, Project 5035, International Space Cooperative R&D, efforts transferred from PE 0603790F, NATO Cooperative R&D, Project 64NATO, NATO Cooperative R&D, in conjunction with the Space Commission recommendation to consolidate all space unique activities.
0603851F ICBM - Dem/Val	In FY 2003, Project 1020, ICBM Guidance Applications, includes new start efforts.
	In FY 2003, Project 1023, Rocket System Launch Program, includes new start efforts.

PROGRAM ELEMENT (by BUDGET ACTIVITY)	REMARKS
0603858F Space Based Radar Dem/Val	In FY 2003, this is a new PE.
	In FY 2003, Project A004, SBR Concept & Technical Development, efforts were transferred from PE 0604251F, Space-Based Radar EMD, Project 5009, SBR Concept and Technical Development, in order to correct a database error which loaded the funding in the wrong PE.
0604327F Hardened Target Munitions	In FY 2003, Project 4641, GBU-28 Upgrade, includes new start efforts.
BUDGET ACTIVITY #5: ENGINEERING & MANUFACTURING	DEVELOPMENT (EMD) (Volume II)
0207434F Link 16 Support & Sustainment	In FY 2003, this is a new PE.
	In FY 2003, Project 5049, JINTACCS, efforts transferred from PE 0604779F, Tactical Data Link Interoperability, Project 2189, JINTACCS, in order to comply with CSAF 17 Apr 01 direction to consolidate tactical data link/Link 16 funding and manage tactical data links as an enterprise.
	In FY 2003, Project 5050, TCL System Integration, efforts were transferred from PE 0604754F, Tactical Data Link Integration, Project 4749, Link 16 System Integration, in order to comply with CSAF 17 Apr 01 direction to consolidate tactical data link/Link 16 funding and manage tactical data links as an enterprise.
	In FY 2003, Project 5051, Family of Interoperable Operational Pictures (FIOP), efforts were transferred from PE 0604754F, Tactical Data Link Integration, Project 4992, Family of Interoperable Operational Pictures (FIOP), in order to comply with CSAF 17 Apr 01 direction to consolidate tactical data link/Link 16 funding and manage tactical data links as an enterprise.
0401318F CV-22	In FY 2003, Project 4103, CV-22, includes new start efforts.
0604226F B-1B	In FY 2003, Project Number 4596, B-1B, includes new start efforts.
0604240F B-2 Advanced Tech Bomber	In FY 2003, Project 3843, B-2 Advanced Technology Bomber, includes new start efforts.
0604251F Space Based Radar EMD	In FY 2003, Project 5009, SBR Concept and Technical Development, efforts were transferred to PE 0603858F, Space Based Radar Dem/Val, Project A004, SBR Concept & Technical Development.

PROGRAM ELEMENT (by BUDGET ACTIVITY)	REMARKS
0604421F Counter Space Systems	In FY 2003, this is a new PE.
	In FY 2003, Project A001, Counter Satellite Communications System, efforts were transferred from PE 0603438F, Space Control Technology, Project 2611, Technology Insertion Plan & Analysis, in order to begin system Engineering and Manufacturing Development activities.
	In FY 2003, Project A002, Counter Surveillance Reconnaissance System, efforts were transferred from PE 0603438F, Space Control Technology, Project 2611, Technology Insertion Plan & Analysis, in order to begin system Engineering and Manufacturing Development activities.
	In FY 2003, Project A003, Rapid Attack Identification Detection & Reporting System (RAIDRS), includes new start efforts.
	In FY 2003, Project A003, Rapid Attack Identification Detection & Reporting System (RAIDRS), efforts were transferred from PE 0603438F, Space Control Technology, Project 2611, Technology Insertion Plan & Analysis, in order to begin system Engineering and Manufacturing Development activities.
0604617F Agile Combat Support	In FY 2003, Project 2895, Civil Engineering Readiness, includes new start efforts.
0604735F Combat Training Ranges	In FY 2003, Project 2286, Combat Training Ranges, includes new start efforts.
0604754F Tactical Data Link Integration	In FY 2003, Project 4749, Link 16 System Integration, efforts were transferred to PE 0207434F, Link 16 Support and Sustainment, Project 5050, TCL System Integration, in order to comply with CSAF 17 Apr 01 direction to consolidate tactical data link/Link 16 funding and manage tactical data links as an enterprise.
	In FY 2003, Project 4992, Family of Interoperable Operational Pictures (FIOP), efforts transferred to PE 0207434F, Link 16 Support and Sustainment, Project 5051, Family of Interoperable Operational Pictures (FIOP), in order to comply with CSAF 17 Apr 01 direction to consolidate tactical data link/Link 16 funding and manage tactical data links as an enterprise.
0604779F Tactical Data Link Interoperability	In FY 2003, Project 2189, JINTACCS, efforts transferred to PE 0207434F, Link 16 Support and Sustainment, Project 5049, JINTACCS, in order to comply with CSAF 17 Apr 01 direction to consolidate tactical data link/Link 16 funding and manage tactical data links as an enterprise.

INTRODUCTION AND EXPLANATION OF CONTENTS

PROGRAM ELEMENT (by BUDGET ACTIVITY)	REMARKS
0604851F ICBM - EMD	In FY 2003, Project 4823, Environmental Control System (ECS) Replacement Program, includes new start efforts.
BUDGET ACTIVITY #6: MANAGEMENT & SUPPORT (Volum	e II)
0604256F Threat Simulator Development	In FY 2003, Project 3321, EW Ground Test Resources, includes new start efforts.
0604759F Major Test and Evaluation Investment	In FY 2003, Project 4597, Air Force Test Investments, includes new start efforts.
BUDGET ACTIVITY #7: OPERATIONAL SYSTEMS DEVELOR	PMENT (Volume III)
0101120F Advanced Cruise Missile (ACM)	In FY 2003, Project 4798, Life Extension Program, was renamed (formerly Life Extension Study). This action did not change program content.
	In FY 2003, Project 4798, Life Extension Program, includes new start efforts.
0207134F F-15E Squadrons	In FY 2003, Project 670131, F-15E First Shooter (ALR-56C Processor Upgrade), includes new start efforts.
0207138F F-22 Squadrons	In FY 2003, Project 4785, F-22, includes new start efforts.
0207423F Advanced Communications Systems	In FY 2003, Project 4935, Joint Tactical Radio Systems (JTRS), includes new start efforts.
0207445F Fighter Tactical Data Link	In FY 2003, this is a new PE.
	In FY 2003, Project 5043, Fighter Tactical Data Link includes a new start efforts.
	In FY 2003, Project 5043, Fighter Tactical Data Link, efforts were transferred from PE 0207131F, A-10 Squadrons, Project 4809, A-10 Squadrons, in order to comply with CSAF 17 Apr 01 direction to consolidate tactical data link/Link 16 funding and manage tactical data links as an enterprise.

0207449F Multi-Sensor Command and Control Constellation In FY 2003, this is a new PE. (MC2C)

PROGRAM ELEMENT (by BUDGET ACTIVITY)	REMARKS
	In FY2003, Project 5064, Airframe, efforts were transferred from PE 0207581F, Joint Stars, Project 0003, JSTARS, in order to support transition to a new platform.
	In FY2003, Project 5065, Sensors, efforts were transferred from PE 0207581F, Joint Stars, Project 0003, JSTARS, in order to support transition to a new platform.
0207581F JOINT STARS	In FY 2003, Project 0003, JSTARS, efforts were transferred to PE 0207449F, Multi-Sensor Command and Control Constellation (MC2C), Project 5064, Airframe, in order to support transition to a new platform.
	In FY 2003, Project 0003, JSTARS, efforts were transferred to PE 0207449F, Multi-Sensor Command and Control Constellation (MC2C), Project 5065, Sensors, in order to support transition to a new platform.
0303131F Minimum Essential Emergency Communications Network (MEECN)	In FY 2003, Project 4610, Minuteman MEECN Program (MMP), was renamed (formerly MEECN EHF). This action did not change program content.
0303141F Global Combat Support System (GCSS)	In FY 2003, Project 4655, Integrated Logistics System - Supply (ILS-S), efforts were transferred to PE 0708611, Support Systems Development, Project 5044, Log Application Integrated Logistics System - Supply (LAILS-S) in order to align functional application development efforts into separate functional PE's.
	In FY 2003, 4904, Logistics Integration efforts transferred to PE 0708611F, Support Systems Development (SSD), Project 5042, Log Application Logistics Integration (LALI), in order to align functional application development efforts into separate functional PE's.
	In FY 2003, Project 4905, GCSS-AF Architectural Development, efforts were transferred to Project 5046, System Engineering and Integration (SE&I), in order to provide logical program grouping and allow for more effective oversight of this project.
	In FY 2003, Project 5046, SE&I, efforts were transferred from Project 4905, GCSS-AF Architectural Development.
	In FY 2003, Project 4906, GCSS-AF Domain Integration, efforts were transferred to Project Number 5046, System Engineering and Integration (SE&I), in order to provide logical program grouping and allow for more effective oversight of this project.

PROGRAM ELEMENT (by BUDGET ACTIVITY)	REMARKS
	In FY 2003, Project 5046, SE&I, efforts were transferred from Project 4906, GCSS-AF Domain Integration.
	In FY 2003, Project 4907, Financial Information Resource System (FIRST), efforts were transferred to PE 0901538F, FIRST, Project 5036, FIRST.
0303601F MILSATCOM Terminals	In FY 2003, Project 2487, Milsatcom Terminals, includes new start efforts.
0305148F Air Force Tactical Measurement & Signatures	In FY 2003, this is a new PE.
	In FY 2003, Project 5053, Air Force Tactical Measurement & Signatures, includes new start efforts.
0305182F Spacelift Range System	In FY 2003, Project 4137, Range Standardization and Automation (RSA), was renamed Launch and Test Range System (LTRS) Modernization, to better depict on-going efforts.
0305205F Endurance Unmanned Aerial Vehicles	In FY 2003, Project 4883, JTC/SIL MUSE, efforts were transferred from PE 0308601F, Modeling and Simulation Support, Project 5052, JTC/SIL MUSE, in order to comply with 1999 PBD 220.
0305207F Manned Reconnaissance System	In FY 2003, Project 4754, Cobra Ball, includes new start efforts.
0308601F Modeling and Simulation Support	In FY 2003, Project 5052, JTC/SIL MUSE, were efforts transferred from PE 0305205F, Endurance Unmanned Aerial Vehicles, Project 4883, JTC/SIL MUSE in order to comply with 1999 PBD 220.
0401130F C-17 Aircraft Squadrons	In FY 2003, Project 2569, C-17, includes new start efforts.
0401839F Airlift/Other Tactical Data Link	In FY 2003, this is a new PE.
0708012F Logistic Support Activities	In FY 2003, Project 5054, Core Automated Maintenance System (CAMS) Modernization, efforts were transferred from PE 0708611F, Support Systems Development, Project 4654, Integrated Maintenance Data System (IMDS), in order to modernize the CAMS system to a level where it can be converted to IMDS.

PROGRAM ELEMENT (by BUDGET ACTIVITY)	REMARKS
0708611F Support Systems Development	In FY 2003, Project 4654, Integrated Maintenance Data Systems, efforts transferred to PE 0708012F, Logistics Support Activities, Project 5054, CAMS, in order to provide funding to modernize the project.
	In FY 2003, Project 5042, Log Application Logistics Integration (LALI), efforts were transferred from PE 0303141F, Global Command Support System (GCSS), 4904, Logistics Integration in order to align functional application development efforts into separate functional PE's.
	In FY 2003, Project 5044, Log Application Integrated Logistics System - Supply (LAILS-S), efforts were transferred from PE 0303141F, Global Combat Support System (GCSS), 4655, Integrated Logistics System-Supply (ILS-S), in order to align functional application development efforts into separate functional PE's.
	In FY 2003, Project 5042, Log Application Logistics Integration (LALI), efforts transferred to PE 0303141F, Global Combat Support System, Project 4904, Logistics Integration , in order to align functional application development efforts into separate functional PE's.
0905138F Financial Information Resources System (FIRST)	In FY 2003, this is a new PE.
	In FY 2003, project 5036, Financial Information Resource System (FIRST), efforts were transferred from PE 0303141F, GCSS-AF, project 4907, Financial Information Resource System (FIRST), in order to provide logical program grouping and allow for more effective oversight of this project.

PE PROGRAM ELEMENT TITLE

PAGE

#1 - Basic Research

		Volume I	
1	0601102F	Defense Research Sciences	1

#2 - Applied Research

		Volume I	
2	0602102F	Materials	49
3	0602201F	Aerospace Vehicle Technologies	69
4	0602202F	Human Effectiveness Applied Research	83
5	0602203F	Aerospace Propulsion	105
6	0602204F	Aerospace Sensors	131
7	0602500F	MULTI-DISCIPLINARY SPACE TECH	157
8	0602601F	Space Technology	179
9	0602602F	Conventional Munitions	197
10	0602605F	DIRECTED ENERGY TECHNOLOGY	211
11	0602702F	Command Control and Communications	223
12	0602805F	Dual Use Science & Technology	241

#3 - Advanced Technology Development

		Volume I	
13	0603106F	Logistics Systems Technology	247
14	0603112F	Advanced Materials for Weapon Systems	251
15	0603202F	Aerospace Propulsion Subsystems Integration	267
16	0603203F	Advanced Aerospace Sensors	271
17	0603205F	Flight Vehicle Technology	285
18	0603211F	Aerospace Technology Dev/Demo	291
19	0603216F	Aerospace Propulsion and Power Technology	301

PE PROGRAM ELEMENT TITLE

PAGE

20	0603227F	Personnel Training and Simulation Technology	323
21	0603231F	Crew Systems and Personnel Protection Technology	327
22	0603245F	Flight Vehicle Technology Integration	345
23	0603253F	Advanced Sensor Integration	349
24	0603270F	Electronic Combat Technology	355
25	0603302F	Space and Missile Rocket Propulsion	367
26	0603311F	Ballistic Missile Technology	373
27	0603333F	Unmanned Air Vehicle Dev/Demo	377
28	0603401F	Advanced Spacecraft Technology	381
29	0603410F	Space Systems Environmental Interactions Technology	405
30	0603436F	Transformational Wideband MILSATCOM	409
31	0603444F	MAUI SPACE SURVEILLANCE SYSTEM	413
32	0603500F	MULTI-DISCIPLINARY ADV DEV SPACE TEC	417
33	0603601F	Conventional Weapons Technology	431
34	0603605F	Advanced Weapons Technology	441
35	0603723F	Environmental Engineering Technology	457
36	0603726F	Aerospace Info Tech Sys Integration	461
37	0603789F	C3I Advanced Development	467
39	0603876F	Space Based Laser	485

#4 - Demonstration and Validation

	Volume II	
0603260F	Intelligence Advanced Development	489
0603319F	Airborne Laser Technology	511
0603421F	GLOBAL POSITIONING SYSTEM	517
0603430F	Advanced (EHF MILSATCOM (Space)	523
0603432F	Polar MILSATCOM (Space)	529
	0603260F 0603319F 0603421F 0603430F 0603432F	Volume II0603260FIntelligence Advanced Development0603319FAirborne Laser Technology0603421FGLOBAL POSITIONING SYSTEM0603430FAdvanced (EHF MILSATCOM (Space)0603432FPolar MILSATCOM (Space)

PAGE

PE PROGRAM ELEMENT TITLE

0603434F 539 45 National Polar-Orbiting Operational Environmental Satellite System (NPOESS) 0603438F Space Control Technology 547 46 0603617F Command Control and Communication Applications 555 47 0603742F Combat Identification Technology 575 48 0603790F NATO Cooperative R&D 583 49 0603791F 607 50 International Space Cooperative R&D 51 0603800F Joint Strike Fighter 613 52 0603845F ADVANCED WIDEBAND SYSTEM (AWS) 625 0603850F 53 Integrated Broadcast Service (DEM/VAL) 631 54 0603851F 637 ICBM - DEM/VAL 0603854F 55 Wideband MILSATCOM (Space) 665 0603856F Air Force/National Program Cooperation (AFNPC) 679 56 0603858F Space-Based Radar Dem/Val 685 57 0603859F 58 **Pollution Prevention** 691 0603860F Joint Precision Approach and Landing Systems - Dem/Val 697 59 Hardened Target Munitions 60 0604327F 705 0604731F Unmanned Combat Air Vehicle (UCAV) 711 Ν

#5 - Engineering and Manufacturing Development

		Volume II	
98	0207249F	Precision Attack Systems	715
99	0207434F	Link 16 Support and Sustainment	719
100	0207701F	Full Combat Mission Training	737
101	0305176F	Combat Survivor Evader Locator	741
102	0401318F	CV-22	747
62	0603840F	Global Broadcast Service (GBS)	753
63	0604012F	Joint Helmet Mounted Cueing System (JHMCS)	759

PAGE

PE PROGRAM ELEMENT TITLE

64	0604222F	Nuclear Weapons Support	765
65	0604226F	B-1B	787
66	0604227F	Distributed Mission Training (DMT)	797
67	0604233F	Specialized Undergraduate Pilot Training	803
68	0604239F	F-22 EMD	815
69	0604240F	B-2 Advanced Technology Bomber	831
70	0604251F	SPACE-BASED RADAR EMD	839
71	0604270F	EW Development	845
72	0604280F	JOINT TACTICAL RADIO SYSTEMS (JTRS)	875
73	0604329F	Small Diameter Bomb	879
74	0604421F	Counterspace Systems	885
75	0604441F	Space Based Infrared Systems (SBIRS) High EMD	897
76	0604442F	Space Based Infrared Systems (SBIRS) Low	903
77	0604479F	MILSTAR LDR/MDR Sat Comm	909
78	0604602F	Armament/Ordnance Development	917
79	0604604F	Submunitions	931
80	0604617F	Agile Combat Support	937
81	0604618F	Joint Direct Attack Munition	951
82	0604703F	Aeromedical Systems Development	957
83	0604706F	Life Support Systems	963
84	0604727F	Joint Standoff Weapons Systems	971
86	0604735F	Combat Training Ranges	977
87	0604740F	Integrated Command & Control Applications	985
88	0604750F	Intelligence Equipment	995
89	0604754F	Tactical Data Link Integration	1,003
90	0604762F	Common Low Observable Verification Sys	1,021
91	0604779F	Tactical Data Link Interoperability	1,027

	PE	PROGRAM ELEMENT TITLE	PAGE
92	0604800F	Joint Strike Fighter EMD	1,035
93	0604805F	Commercial Operations and Support Savings Initiative	1,043
94	0604851F	ICBM - EMD	1,049
95	0604853F	Evolved Expendable Launch Vehicle - EMD	1,077
96	0605011F	RDT&E For Aging Aircraft	1,085
#6 - Management a	and Support		
-		Volume II	
103	0604256F	Threat Simulator Development	1,093
104	0604759F	Major T&E Investment	1,105
105	0605101F	RAND Project Air Force	1,117
106	0605306F	Ranch Hand II Epidemiology Study	1,121
108	0605712F	Initial Operational Test & Evaluation	1,125
109	0605807F	Test and Evaluation Support	1,135
110	0605860F	Rocket Systems Launch Program (RSLP)	1,147
111	0605864F	Space Test Program	1,151
Ν	0804731F	GENERAL SKILL TRAINING	1,155
114	0909980F	JUDGEMENT FUND REIMBURSEMENT	1,157
115	1001004F	International Activities	1,159

#7 - Operational System Development Volu

		Volume III	
117	0101113F	B-52 SQUADRONS	1,167
118	0101120F	ADVANCED CRUISE MISSILE	1,179
119	0101122F	AIR LAUNCHED CRUISE MISSILE	1,185
120	0101313F	STRAT WAR PLANNING SYS - USSTRATCOM	1,193
122	0102326F	REGION/ SECTOR OPERATIONS CONTROL CENTER	1,201

PE PROGRAM ELEMENT TITLE

PAGE

123	0203761F	Warfighter Rapid Acquisition Program	1,207
124	0207027F	Air Space Command & Control Agency	1,211
125	0207028F	Joint Expeditionary Force Experiment	1,217
126	0207131F	A-10 SQUADRONS	1,233
127	0207133F	F-16 SQUADRONS	1,239
128	0207134F	F-15E SQUADRONS	1,247
129	0207136F	Manned Destructive Suppression	1,255
130	0207138F	F-22 SQUADRONS	1,261
131	0207141F	F-117A SQUADRON	1,267
132	0207161F	Tactical AIM Missiles	1,273
133	0207163F	Advanced Medium Range Air-to-Air Missile	1,279
134	0207247F	Air Force TENCAP	1,285
136	0207253F	Compass Call	1,291
137	0207268F	Aircraft Engine Component Improvement Program (CIP)	1,297
138	0207277F	Chief's Innovation Program	1,303
139	0207325F	Joint Air-to-Surface Standoff Missile (JASSM)	1,307
140	0207410F	AEROSPACE OPERATION CENTER (AOC)	1,313
141	0207412F	Modular Control System	1,319
142	0207417F	Airborne Warning and Control System (AWACS)	1,325
143	0207423F	Advanced Communications Systems	1,333
146	0207438F	Theater Battle Management (TBM) C4I	1,347
147	0207445F	FIGHTER TACTICAL DATA LINK	1,363
148	0207449F	Multi-sensor Command and Control Constellation (MC2C)	1,367
149	0207581F	JOINT STARS	1,381
150	0207590F	Seek Eagle	1,397
152	0207601F	USAF Modeling and Simulation	1,403
153	0207605F	Wargaming and Simulation Centers	1,421

PE PROGRAM ELEMENT TITLE PAGE

155	0208006F	Mission Planning Systems	1,425
156	0208021F	Information Warfare Support	1,433
157	0208031F	WRM-EQUIPMENT/SECONDARY ITEMS	1,439
158	0208060F	THEATER MISSILE DEFENSES	1,445
161	0208889F	COUNTERDRUG USSOUTHCOM SUPPORT	1,451
167	0302015F	E-4B NATIONAL AIRBORNE OPERATIONS CENTER	1,455
168	0303110F	Defense Satellite Communications System	1,463
169	0303112F	AIR FORCE COMMUNICATIONS	1,469
170	0303131F	Minimum Essential Emergency Communications Network (MEECN)	1,473
171	0303140F	Information Systems Security Program	1,491
172	0303141F	Global Combat Support System (GCSS)	1,511
173	0303150F	WWMCCS/GLOBAL COMMAND & CONTROL SYSTEM	1,547
174	0303401F	Communications Security	1,553
175	0303601F	MILSATCOM Terminals	1,559
178	0305099F	Global Air Traffic Management (GATM)	1,567
179	0305110F	Satellite Control Network	1,579
180	0305111F	WEATHER SERVICE	1,587
181	0305114F	Air Traffic Control/Approach/Landing System (ATCALS)	1,593
182	0305128F	Security And Investigative Activities	1,605
184	0305144F	TITAN SPACE LAUNCH VEHICLES	1,611
185	0305148F	AF Tac Measurement & Sign	1,617
187	0305160F	Defense Meteorological Satellite Program	1,623
188	0305164F	NAVSTAR Global Positioning System User Equipment Space	1,631
189	0305165F	NAVSTAR GPS (Space)	1,641
191	0305182F	Spacelift Range System	1,649
192	0305202F	Dragon U-2 (JMIP)	1,657
193	0305205F	Endurance Unmanned Aerial Vehicles	1,673

PAGE

PE PROGRAM ELEMENT TITLE

0305206F Airborne Reconnaissance Systems 1,695 194 195 0305207F Manned Reconnaissance System 1,721 0305208F Distributed Common Ground Systems 1,725 196 197 0305906F NCMC - TW/AA System 1,737 198 0305910F **SPACETRACK** 1,749 0305911F Defense Support Program 1,769 199 0305913F NUDET Detection System (Space) 1,781 200 0308601F 201 Modeling and Simulation Support 1,787 202 0308699F Shared Early Warning System 1,799 0401115F C-130 AIRLIFT SQUADRONS 1,805 203 0401119F 204 C-5 Airlift Squadrons 1,811 C-17 Aircraft 0401130F 1,825 205 0401132F 1,837 206 C-130J PROGRAM 207 0401134F Large Aircraft InfraRed Counter Measures (LAIRCM) 1,841 0401218F KC-135s 1,847 208 0401219F **KC-10S** 1,855 209 0404011F **Special Operations Forces** 1,861 210 0605024F Anti-Tamper Technology Executive Agent Ν 1,867 211 0702207F Depot Maintenance (Non-IF) 1,871 0708011F Industrial Preparedness 1,877 212 0708012F Logistic Support Activities 1,887 213 24 0708026F Productivity, Reliability, Availability, Maintainability Program 1,893 0708071F Joint Logistics Program - Ammunition System 215 1,899 0708611F Support Systems Development 1,905 216 0708612F Computer Resources Support Improvement Program 1,929 217 SERVICE-WIDE SUPPORT 218 0901212F 1,939 Civilian Compensation Program 1,945 219 0901218F

	PE	PROGRAM ELEMENT TITLE	PAGE
220	0901538F	FIRST	1,949
221	1001018F	NATO AGS	1,953
		Other Exhibits	
		Military Construction Project Data (DD Form 1391)	1,958

Program Element Title	PE	PAGE
A-10 SQUADRONS	0207131F	1,233
Advanced (EHF MILSATCOM (Space)	0603430F	523
Advanced Aerospace Sensors	0603203F	271
Advanced Communications Systems	0207423F	1,333
ADVANCED CRUISE MISSILE	0101120F	1,179
Advanced Materials for Weapon Systems	0603112F	251
Advanced Medium Range Air-to-Air Missile	0207163F	1,279
Advanced Sensor Integration	0603253F	349
Advanced Spacecraft Technology	0603401F	381
Advanced Weapons Technology	0603605F	441
ADVANCED WIDEBAND SYSTEM (AWS)	0603845F	625
Aeromedical Systems Development	0604703F	957
Aerospace Info Tech Sys Integration	0603726F	461
AEROSPACE OPERATION CENTER (AOC)	0207410F	1,313
Aerospace Propulsion	0602203F	105
Aerospace Propulsion and Power Technology	0603216F	301
Aerospace Propulsion Subsystems Integration	0603202F	267
Aerospace Sensors	0602204F	131
Aerospace Technology Dev/Demo	0603211F	291
Aerospace Vehicle Technologies	0602201F	69
AF Tac Measurement & Sign	0305148F	1,617
Agile Combat Support	0604617F	937
AIR FORCE COMMUNICATIONS	0303112F	1,469
Air Force TENCAP	0207247F	1,285
Air Force/National Program Cooperation (AFNPC)	0603856F	679
AIR LAUNCHED CRUISE MISSILE	0101122F	1,185
Air Space Command & Control Agency	0207027F	1,211
Air Traffic Control/Approach/Landing System (ATCALS)	0305114F	1,593
Airborne Laser Technology	0603319F	511

Program Element Title	PE	PAGE
Airborne Reconnaissance Systems	0305206F	1,695
Airborne Warning and Control System (AWACS)	0207417F	1,325
Aircraft Engine Component Improvement Program (CIP)	0207268F	1,297
Anti-Tamper Technology Executive Agent	0605024F	1,867
Armament/Ordnance Development	0604602F	917
B-1B	0604226F	787
B-2 Advanced Technology Bomber	0604240F	831
B-52 SQUADRONS	0101113F	1,167
Ballistic Missile Technology	0603311F	373
C-130 AIRLIFT SQUADRONS	0401115F	1,805
C-130J PROGRAM	0401132F	1,837
C-17 Aircraft	0401130F	1,825
C3I Advanced Development	0603789F	467
C-5 Airlift Squadrons	0401119F	1,811
Chief's Innovation Program	0207277F	1,303
Civilian Compensation Program	0901218F	1,945
Combat Identification Technology	0603742F	575
Combat Survivor Evader Locator	0305176F	741
Combat Training Ranges	0604735F	977
Command Control and Communication Applications	0603617F	555
Command Control and Communications	0602702F	223
Commercial Operations and Support Savings Initiative	0604805F	1,043
Common Low Observable Verification Sys	0604762F	1,021
Communications Security	0303401F	1,553
Compass Call	0207253F	1,291
Computer Resources Support Improvement Program	0708612F	1,929
Conventional Munitions	0602602F	197
Conventional Weapons Technology	0603601F	431
COUNTERDRUG USSOUTHCOM SUPPORT	0208889F	1,451

Program Element Title	PE	PAGE
Counterspace Systems	0604421F	885
Crew Systems and Personnel Protection Technology	0603231F	327
CV-22	0401318F	747
Defense Meteorological Satellite Program	0305160F	1,623
Defense Research Sciences	0601102F	1
Defense Satellite Communications System	0303110F	1,463
Defense Support Program	0305911F	1,769
Depot Maintenance (Non-IF)	0702207F	1,871
DIRECTED ENERGY TECHNOLOGY	0602605F	211
Distributed Common Ground Systems	0305208F	1,725
Distributed Mission Training (DMT)	0604227F	797
Dragon U-2 (JMIP)	0305202F	1,657
Dual Use Science & Technology	0602805F	241
E-4B NATIONAL AIRBORNE OPERATIONS CENTER	0302015F	1,455
Electronic Combat Technology	0603270F	355
Endurance Unmanned Aerial Vehicles	0305205F	1,673
Environmental Engineering Technology	0603723F	457
Evolved Expendable Launch Vehicle - EMD	0604853F	1,077
EW Development	0604270F	845
F-117A SQUADRON	0207141F	1,267
F-15E SQUADRONS	0207134F	1,247
F-16 SQUADRONS	0207133F	1,239
F-22 EMD	0604239F	815
F-22 SQUADRONS	0207138F	1,261
FIGHTER TACTICAL DATA LINK	0207445F	1,363
FIRST	0901538F	1,949
Flight Vehicle Technology	0603205F	285
Flight Vehicle Technology Integration	0603245F	345
Full Combat Mission Training	0207701F	737

Program Element Title	PE	PAGE
GENERAL SKILL TRAINING	0804731F	1,155
Global Air Traffic Management (GATM)	0305099F	1,567
Global Broadcast Service (GBS)	0603840F	753
Global Combat Support System (GCSS)	0303141F	1,511
GLOBAL POSITIONING SYSTEM	0603421F	517
Hardened Target Munitions	0604327F	705
Human Effectiveness Applied Research	0602202F	83
ICBM - DEM/VAL	0603851F	637
ICBM - EMD	0604851F	1,049
Industrial Preparedness	0708011F	1,877
Information Systems Security Program	0303140F	1,491
Information Warfare Support	0208021F	1,433
Initial Operational Test & Evaluation	0605712F	1,125
Integrated Broadcast Service (DEM/VAL)	0603850F	631
Integrated Command & Control Applications	0604740F	985
Intelligence Advanced Development	0603260F	489
Intelligence Equipment	0604750F	995
International Activities	1001004F	1,159
International Space Cooperative R&D	0603791F	607
Joint Air-to-Surface Standoff Missile (JASSM)	0207325F	1,307
Joint Direct Attack Munition	0604618F	951
Joint Expeditionary Force Experiment	0207028F	1,217
Joint Helmet Mounted Cueing System (JHMCS)	0604012F	759
Joint Logistics Program - Ammunition System	0708071F	1,899
Joint Precision Approach and Landing Systems - Dem/Val	0603860F	697
Joint Standoff Weapons Systems	0604727F	971
JOINT STARS	0207581F	1,381
Joint Strike Fighter	0603800F	613
Joint Strike Fighter EMD	0604800F	1,035

Program Element Title	PE	PAGE
JOINT TACTICAL RADIO SYSTEMS (JTRS)	0604280F	875
JUDGEMENT FUND REIMBURSEMENT	0909980F	1,157
KC-10S	0401219F	1,855
KC-135s	0401218F	1,847
Large Aircraft InfraRed Counter Measures (LAIRCM)	0401134F	1,841
Life Support Systems	0604706F	963
Link 16 Support and Sustainment	0207434F	719
Logistic Support Activities	0708012F	1,887
Logistics Systems Technology	0603106F	247
Major T&E Investment	0604759F	1,105
Manned Destructive Suppression	0207136F	1,255
Manned Reconnaissance System	0305207F	1,721
Materials	0602102F	49
MAUI SPACE SURVEILLANCE SYSTEM	0603444F	413
MILSATCOM Terminals	0303601F	1,559
MILSTAR LDR/MDR Sat Comm	0604479F	909
Minimum Essential Emergency Communications Network (MEECN)	0303131F	1,473
Mission Planning Systems	0208006F	1,425
Modeling and Simulation Support	0308601F	1,787
Modular Control System	0207412F	1,319
MULTI-DISCIPLINARY ADV DEV SPACE TEC	0603500F	417
MULTI-DISCIPLINARY SPACE TECH	0602500F	157
Multi-sensor Command and Control Constellation (MC2C)	0207449F	1,367
National Polar-Orbiting Operational Environmental Satellite System (NPOESS)	0603434F	539
NATO AGS	1001018F	1,953
NATO Cooperative R&D	0603790F	583
NAVSTAR Global Positioning System User Equipment Space	0305164F	1,631
NAVSTAR GPS (Space)	0305165F	1,641
NCMC - TW/AA System	0305906F	1,737

Program Element Title	PE	PAGE
Nuclear Weapons Support	0604222F	765
NUDET Detection System (Space)	0305913F	1,781
Personnel Training and Simulation Technology	0603227F	323
Polar MILSATCOM (Space)	0603432F	529
Pollution Prevention	0603859F	691
Precision Attack Systems	0207249F	715
Productivity, Reliability, Availability, Maintainability Program	0708026F	1,893
Ranch Hand II Epidemiology Study	0605306F	1,121
RAND Project Air Force	0605101F	1,117
RDT&E For Aging Aircraft	0605011F	1,085
REGION/ SECTOR OPERATIONS CONTROL CENTER	0102326F	1,201
Rocket Systems Launch Program (RSLP)	0605860F	1,147
Satellite Control Network	0305110F	1,579
Security And Investigative Activities	0305128F	1,605
Seek Eagle	0207590F	1,397
SERVICE-WIDE SUPPORT	0901212F	1,939
Shared Early Warning System	0308699F	1,799
Small Diameter Bomb	0604329F	879
Space and Missile Rocket Propulsion	0603302F	367
Space Based Infrared Systems (SBIRS) High EMD	0604441F	897
Space Based Infrared Systems (SBIRS) Low	0604442F	903
Space Based Laser	0603876F	485
Space Control Technology	0603438F	547
Space Systems Environmental Interactions Technology	0603410F	405
Space Technology	0602601F	179
Space Test Program	0605864F	1,151
Space-Based Radar Dem/Val	0603858F	685
SPACE-BASED RADAR EMD	0604251F	839
Spacelift Range System	0305182F	1,649

Program Element Title	PE	PAGE
SPACETRACK	0305910F	1,749
Special Operations Forces	0404011F	1,861
Specialized Undergraduate Pilot Training	0604233F	803
STRAT WAR PLANNING SYS - USSTRATCOM	0101313F	1,193
Submunitions	0604604F	931
Support Systems Development	0708611F	1,905
Tactical AIM Missiles	0207161F	1,273
Tactical Data Link Integration	0604754F	1,003
Tactical Data Link Interoperability	0604779F	1,027
Test and Evaluation Support	0605807F	1,135
Theater Battle Management (TBM) C4I	0207438F	1,347
THEATER MISSILE DEFENSES	0208060F	1,445
Threat Simulator Development	0604256F	1,093
TITAN SPACE LAUNCH VEHICLES	0305144F	1,611
Transformational Wideband MILSATCOM	0603436F	409
Unmanned Air Vehicle Dev/Demo	0603333F	377
Unmanned Combat Air Vehicle (UCAV)	0604731F	711
USAF Modeling and Simulation	0207601F	1,403
Warfighter Rapid Acquisition Program	0203761F	1,207
Wargaming and Simulation Centers	0207605F	1,421
WEATHER SERVICE	0305111F	1,587
Wideband MILSATCOM (Space)	0603854F	665
WRM-EQUIPMENT/SECONDARY ITEMS	0208031F	1,439
WWMCCS/GLOBAL COMMAND & CONTROL SYSTEM	0303150F	1,547

	RDT&E BUDGET ITEM J	USTIFIC		SHEET	(R-2 E)	(hibit)		DATE	Februa	ry 2002
BUDGE1 01 - B	UDGET ACTIVITY PE NUMBER AND TITLE 01 - Basic Research 0601102F Defense Research 0601102F									
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	206,638	226,322	219,144	228,597	232,642	236,796	241,347	Continuing	TBD
2301	Physics	24,704	24,084	22,801	23,368	24,287	24,783	25,285	Continuing	TBD
2302	Solid Mechanics and Structures	11,114	11,439	11,881	12,049	11,987	12,222	12,464	Continuing	TBD
2303	Chemistry	25,852	28,806	29,578	29,904	31,023	31,621	32,218	Continuing	TBD
2304	Mathematical and Computer Sciences	32,061	35,079	33,169	34,879	34,576	35,253	35,923	Continuing	TBD
2305	Electronics	23,444	27,498	24,565	26,494	26,305	26,803	27,300	Continuing	TBD
2306	Materials	13,621	16,355	15,004	17,574	18,464	18,791	19,122	Continuing	TBD
2307	Fluid Mechanics	9,395	9,954	10,599	11,274	12,147	12,383	12,630	Continuing	TBD
2308	Propulsion	20,937	23,104	21,190	21,635	22,102	22,505	22,914	Continuing	TBD
2311	Space Sciences	14,408	16,690	15,531	16,066	16,605	16,938	17,279	Continuing	TBD
2312	Biological Sciences	13,114	13,844	14,383	14,730	15,025	15,324	15,629	Continuing	TBD
2313	Human Performance	13,747	12,885	13,044	13,113	12,471	12,706	12,965	Continuing	TBD
			Page	1 of 47 Pag	es			E	Exhibit R-2 (PE 0601102F)

UNCLASSIFIED

	RDT&E BUDGET ITEM J	JSTIFIC	CATION	SHEET	(R-2 E)	chibit)		DATE	Februa	ary 2002
BUDGET ACTIVITY PE NUMBER AND TITLE 01 - Basic Research 0601102F Defense Research Sciences										
4113	External Research Programs Interface	4,241	6,584	7,399	7,511	7,650	7,467	7,618	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	Continuing	TBD
(U)	A. Mission Description The Defense Research Sciences program comprises Research Laboratory. The program element funds fu areas are: (1) physics; (2) solid mechanics and struc (8) propulsion; (9) space sciences; (10) biological sc harmonize efforts, eliminate duplication, and ensure planning and technical review by tri-Service scientif million for Coal-Derived Jet Fuel, \$1.3 million for F Solar Geophysical Interactions.	extramural r indamental l tures; (3) ch iences; and (the most eff ic planning g ocused Ion l	esearch activ broad-based emistry; (4) (11) human j fective use of groups. Note Beam System	vities in acad scientific and mathematica performance. f funds across e: In FY 200 ns, \$1.0 milli	emia and in d engineerir l and comp All projec s the Depart 2, Congress on for the C	dustry and in ng research in uter sciences ts are coordinates tment of Def s added \$2.0 California Sc	n-house inven n areas critic ; (5) electron nated throug ense. All re million for t ience Center	estigations p cal to Air Fo nics; (6) mat the Defen search areas the Center for and \$0.75	erformed in a rce weapon s terials; (7) fli se Reliance p s are subject or Adaptive (million for t	the Air Force systems. These uid mechanics; process to to long-range Optics, \$2.5 he Center for
(U)	<u>B. Budget Activity Justification</u> This program is Budget Activity 1, Basic Research, I directed toward increasing knowledge and understan	because it fu ding in thos	nds scientifi e fields of sc	c study and e	experimenta gineering re	tion. Through the to long	gh this progr g-term nation	ram, the Air nal security	Force invest needs.	s in research
(U)	C. Program Change Summary (\$ in Thousands)									
(U) (U) (U)	Previous President's Budget Appropriated Value Adjustments to Appropriated Value				<u>FY 200</u> 212,688 213,649	11 <u>F</u> 8 2 9 2	<u>Y 2002</u> 20,869 28,419	<u>FY 20</u> 213,78	<u>03</u> 38	<u>Total Cost</u>
	a. Congressional/General Reductionsb. Small Business Innovative Researchc. Omnibus or Other Above Threshold Reprogramd. Below Threshold Reprogram				-5,050)	-2,097			
	e. Rescissions				-1,96	1				
(U) (U)	Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR				206,638	8 2	26,322	5,35 219,14	56 14	TBD
			Page	2 of 47 Page	es			E	Exhibit R-2	(PE 0601102F)
	RDT&E BUDGET ITEM JUSTIFICA	DATE February 2002								
---------------------	--	--	------------------------------------							
виро 01 -	GET ACTIVITY - Basic Research	eiences								
(U)	C. Program Change Summary (\$ in Thousands) Continued									
(U)	Significant Program Changes: Fiscal Year 2002 increase of \$10.0M for nanosatellites, quantum co generation aerospace vehicles is part of the recent DoD Strategy Re Fiscal Year 2002 additional increase of \$4.2M reflects zero percent	omputing, materials engineering, super energetic propella view. real growth.	ints, and plasma dynamics for next							
	D. Execution - Not Applicable.									
I										
I										
I										
		Page 3 of 47 Pages	Exhibit R-2 (PE 0601102F)							

	RDT&	E BUDGET ITEM JU	STIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	nry 2002
BUD0 01 -	BET ACTIVITY Basic Researc	h			PE NUMBE	r and title 2F Defer	nse Rese	arch Sci	ences		PROJECT 2301
	COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2301	Physics		24,704	24,084	22,801	23,368	24,287	24,783	25,285	Continuing	TBD
(U)	J) <u>A. Mission Description</u> Physics research aims to revolutionize advances in laser technologies, sensors and imaging, miniature satellites, and communications. It expands fundamental knowledge of optics, electromagnetics, as well as microwaves and plasmas. The goals are to enable and enhance technologies critical to Air Force lasers, optics, avionics, and microwaves and to improve technologies associated with non-intrusive / non-destructive testing and analysis. Research topics focus on revolutionary improvements in electromagnetic countermeasures, protection against nuclear weapons effects, communications, small satellites, and novel sensors. The primary areas of research investigated by this project are laser and optical physics: atomic molecular and imaging physics: and plasma physics.										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$9,662	Performed laser and optical p fatal damage of infrared-seek and solid state lasers and lase laser to replace oxygen-ioding generation and control of mill micro-electro-mechanical sys	hysics resea ing missiles, r arrays thro e for next ge limeter wave tems (MEM	rch for new t high perfor- ugh experimeneration air es and wideb S) and laser	technologies mance radar tents and sys borne lasers. band optical a photochemi	associated v s, and new d tem modelir Examined modulation t cal processes	with laser de irected energing to advanc pico-second o enhance h	vices and co gy weapons. e laser techn and femto-s igh-perform pecialized de	ntrols towar Continued ology. Inve econd (extra ance radars. evices for m	ds enabling s to investigat stigated a ne emely fast) la Expanded s icro-satellite	spoofing and e semiconductor w high-power asers for tudies of applications.
(U)	 \$7,450 \$7,450 Conducted research in plasma physics to investigate fundamental atomic and molecular interactions for future directed energy weapons, affordable low-observables, and space communications and surveillance. Explored physics issues relating to plasma processing of materials at atmospheric pressures to contribute to higher frequency, more efficient, high power microwave systems. Examined the controlled resistive, dielectric, and conducting behavior of plasmas, and the effects of plasmas on transmission, reflection, and absorption of electromagnetic waves to enable novel stealth aircraft mechanisms. Investigated the feasibility of using collisional ionized gas volumes to protect friendly assets from 										
(U)	J) \$4,175 Studied atomic, molecular, and imaging physics to evaluate the interaction of atoms, molecules, and ions to provide basic information for use in improved explosives and fuels, enhanced space surveillance, superior communications, precision navigation, and the neutralization of biological threats. Investigated the trapping and cooling of atoms and ions to enrich high-resolution spectroscopy. Characterized interactions of atoms in strong fields to discover novel lasers for Air Force applications. Continued to examine isomeric, very high density energy storage for flash radiation devices and to make long flight missions possible without refueling.										
Р	roject 2301			Page	4 of 47 Pag	es			Ex	hibit R-2A	(PE 0601102F)

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002
вирс 01 -	GET ACTIVITY • Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT 2301
(U)	A. Mission Description	on Continued	
(U) (U)	FY 2001 (\$ in Thousa \$3,417	nds) Continued Studied the performance of the new 30-meter infrared adaptive optical telescope at the Center for Astronomic research on adaptive optics to enable adaptive telescopes for laser beam projection into space, space reconna- and space-based lasers.	cal Active Optics. Continued issance, space power collectors,
(U)	\$24,704	Total	
(U)	FY 2002 (\$ in Thousa	<u>nds</u>)	
(U)	\$9,936	Perform laser and optical physics research for new concepts in solid state lasers, especially fiber lasers, to att in the one kilowatt average power range. The results of this research will enable spoofing and fatal damage of improve high performance radars, and new directed energy weapons. Study techniques for integrating modul levels at affordable cost and useful size for application to airborne or space platforms. Study concepts for acc deep space objects using very large aperture adaptive telescopes. Explore novel low-cost light sources for hi of high intensity and spectral brightness for disinfection of biological agents, the synthesis of chemical agent paint.	ain compact, inexpensive modules of infrared-seeking missiles, les to achieve multiple power hieving very high resolution of gh-power ultraviolet lasers capable s, and safely stripping aircraft
(U)	\$7,748	Conduct research in plasma physics to investigate fundamental interactions between charged particles and ele directed energy weapons, affordable low-observables, and space communications/surveillance. Explore phys production and maintenance of substantial volumes of low-temperature plasma at atmospheric pressures for p reduction. Investigate the controlled resistive, conducting, and dielectric behavior of plasmas, and the effects reflection, and transmission of electromagnetic waves to create new stealth aircraft mechanisms. Examine the ionized gas volumes to shield friendly assets from directed energy threats.	ectromagnetic fields for future ics relating to the power-efficient plasma-based aerodynamic drag s of plasmas on absorption, he viability of using collisional
(U)	\$4,419	Study atomic, molecular, and imaging physics to evaluate the interaction of atoms, molecules, and ions for us fuels, enhanced space surveillance, superior communications, precision navigation, and the neutralization of interactions of atoms in strong electromagnetic fields to enable novel lasers for Air Force applications. Cont high density energy storage for flash radiation devices to diminish or eliminate refueling on long endurance f holographic films for correction of distortion and aberration in space surveillance telescopes.	se in improved explosives and biological threats. Quantify inue research on isomeric, very lights. Investigate the use of
(U)	\$1,981	Continue to enhance the research performance of the new 30-meter infrared adaptive optical telescope at the Optics. Continue research studies on adaptive optics to enable adaptive telescopes for laser beam projection space power collectors, and space-based lasers.	Center for Astronomical Active into space, space reconnaissance,
Р	roject 2301	Page 5 of 47 Pages	Exhibit R-2A (PE 0601102F)

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002
вира 01 -	GET ACTIVITY • Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT 2301
(U)	A. Mission Descripti	on Continued	
(U) (U)	<u>FY 2002 (\$ in Thousa</u> \$24,084	nds) Continued Total	
(U) (U)	<u>FY 2003 (\$ in Thousa</u> \$10,261	nds) Conduct laser and optical physics research to study the effect of combining high power solid state lasers with forming optics. Study concepts to achieve high output powers at wavelengths required for space applications aperture adaptive telescopes for very high resolution deep space imaging. Explore large, light-weight adaptiv high energy laser relay applications. Study laser micro-machining techniques for producing specialized space multi-functional micro- and nano-satellites	n integrated nonlinear and pulse s. Continue studies of large ve optics for space surveillance and the micro-systems for
(U)	\$7,981	Conduct research in plasma physics to investigate fundamental interactions between charged particles and ele directed-energy weapons, affordable low-observables, and space communications and surveillance. Explore dynamic molecular interactions in combustion and high energy density propellants. Examine the detailed ph breakdown in the presence of strong electric fields. These fundamental findings will facilitate creation of mo- portable pulsed power systems to power future directed-energy weapons systems.	ectromagnetic fields for future physics topics relating to the ysics of material, surface, and air ore compact, lighter weight,
(U)	\$4,559	Study atomic, molecular, and imaging physics to evaluate the interaction of atoms, molecules, and ions to pre- explosives and fuels, enhanced space surveillance, superior communications, precision navigation, and the neu- Investigate fundamental interplay between atoms and strong electromagnetic fields to create new classes of 1 Develop isomeric, high energy density storage for flash radiation devices to diminish or eliminate refueling r flights. Continue basic research of holographic films for correction of distortion and aberration in space surve emission cross sections from electron impact to provide fundamental data needed in satellite surveillance.	ovide basic information to improve eutralization of biological threats. asers for Air Force applications. requirements on long endurance reillance telescopes. Measure UV
(U)	\$22,801	Total	
(U)	B. Project Change S Not Applicable.	immary	
(U) (U) (U) (U) (U)	C. Other Program File Related Activities: PE 0602203F, Aerosp PE 0602601F, Space T PE 0602204F, Aerosp	Inding Summary (\$ in Thousands) ace Propulsion. Technology. ace Sensors.	
Р	roject 2301	Page 6 of 47 Pages	Exhibit R-2A (PE 0601102F)

BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT 01 - Basic Research 0601102F Defense Research Sciences 2301 (1) C. Other Program Funding Summary (5 in Thousands) (1) P. 6060205F, Directed Energy Technology. (1) D. Acquisition Strategy Not Applicable. (1) D. Acquisition Strategy (1) D. Schedule Profile (1) Not Applicable. (1) D. Schedule Profile (1) Not Applicable. (1) Not Applicable. (2) Not Applicable. (2) Not Applicable. (2) Not Applicable.		RDT&E BUDGET ITEM JUSTIFICATIO	DATE February 2002	
U) C. Other Program Funding Summary (S in Thousands) (I) PE 0602603F, Directed Energy Technology. (I) D. Acquisition Strategy Not Applicable. (I) E. Schedule Profile (I) Not Applicable. (II) Not Applicable. (III) Not Applicable. (III) Not Applicable. (III) Not Applicable.	BUDO 01 -	BET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT
(1) D. Acquisition Strategy Not Applicable. (1) E. Schedule Profile (1) Not Applicable.	(U) (U)	C. Other Program Funding Summary (\$ in Thousands) PE 0602605F, Directed Energy Technology.		
(U) E. Schedule Profile (U) Not Applicable. Project 2301 Page 7 of 47 Pages Exhibit R-2A (PE 0601102F)	(U)	D. Acquisition Strategy Not Applicable.		
Project 2301 Page 7 of 47 Pages Exhibit R-2A (PE 0601102F)	(U) (U)	<u>E. Schedule Profile</u> Not Applicable.		
Project 2301 Page 7 of 47 Pages Exhibit R-2A (PE 0601102F)				
Project 2301 Page 7 of 47 Pages Exhibit R-2A (PE 0601102F)				
Project 2301 Page 7 of 47 Pages Exhibit R-2A (PE 0601102F)				
Project 2301 Page 7 of 47 Pages Exhibit R-2A (PE 0601102F)				
Project 2301 Page 7 of 47 Pages Exhibit R-2A (PE 0601102F)				
Project 2301 Page 7 of 47 Pages Exhibit R-2A (PE 0601102F)				
Project 2301 Page 7 of 47 Pages Exhibit R-2A (PE 0601102F)				
Project 2301 Page 7 of 47 Pages Exhibit R-2A (PE 0601102F)				
Project 2301 Page 7 of 47 Pages Exhibit R-2A (PE 0601102F)				
	Р	Project 2301 P	age 7 of 47 Pages	Exhibit R-2A (PE 0601102F)

Γ	RDT&I	E BUDGET ITEM JU	JSTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
виро 01 -	BET ACTIVITY Basic Researcl	n			PE NUMBE 060110	R AND TITLE	nse Rese	arch Sci	ences		PROJECT 2302
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2302	Solid Mechanics ar	nd Structures	11,114	11,439	11,881	12,049	11,987	12,222	12,464	Continuing	TBD
(U)	A. Mission Description Solid Mechanics and Structures basic research aims to dramatically improve the behavior of aerospace materials and structures via better description of wear and damage dynamics. It expands fundamental knowledge of the aeroelastic and acoustic behavior of airframes and engine structures as well as the fluid behavior of launch vehicles and space structures. The goals are cost-effective development and safe, reliable operation of superior Air Force weapons and defensive systems. Research topics include: the design of advanced material structures on the micro- and nano-scale; modeling and simulation of the dynamic behavior of aircraft, missiles, and large space structures; and technology integration for the performance and survivability enhancement of these systems. The primary areas of research investigated by this project are mechanics of composite materials, structural mechanics, and structural dynamics.										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$2,332	ands) Studied mechanics of compose revolutionary improvements in dynamic systems and develop and orbital systems. Continue advanced composite material	site materials in capability o efficient cc ed efforts to	s to investiga and design o mputational seek fundan	ate new struct of air and sp techniques a nental knowl llants and lin	etural concep ace weapon and design n ledge on air	ots and the us systems. Control Contro	nderpinning ontinued to e es for turbine ponents, incl	mechanics r xplore the fi e engines, ain luding metal	principles to indamental t r vehicles, la lic and inter-	enable behavior of unch systems, metallic alloys,
(U)	\$7,157	Conducted structural mechani multi-mission uninhabited air performance prediction of aer structures. Developed technic	ics research vehicles. E rospace syste	to examine i valuated the ems. Identif yze vehicle i	behavior of ied fundame ntegrity and	laptive struct distributed structurs ntal structurs significantly	ture concept sensor and a al design cha	s for deploy ctuator syste aracteristics e structural 1	ment of spaces ms to impro underpinnin ongevity of	ce-based system we the design g the life cyc Air Force we	tems and n and ele of airframe eapons.
(U) (U)	 \$1,625 Performed dynamics and shock physics research to identify the fundamental damage mechanisms in structural materials to model and predict effects of weapon impacts and assess damage of penetrating munitions. Devised fundamental mechanics principles and life-span prediction methodologies to significantly enhance design and life cycle management methodologies of Air Force weapon systems. Investigated the mechanical and dynamic behavior of micro-scale structures to enable micro-electro-mechanical systems (MEMS) that can sense environments and respond accordingly (smart structures). \$11,114 										
Р	roject 2302			Page	8 of 47 Pag	es			Ex	hibit R-2A	(PE 0601102F)

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A	Exhibit)	DATE February 2002
BUD(01 -	GET ACTIVITY • Basic Research	PE NUMBER AND TIT	LE ense Research Science	PROJECT S 2302
(U)	A. Mission Descripti	on Continued		
۵D	FY 2002 (\$ in Thousa	nds)		
(U)	\$2,401	Study mechanics of materials to accelerate utilization of advanced materials composites in aerospace vehicles, turbine engines, space systems, and weaport technology and multiscale modeling to design new materials and new structure mechanics and atomistic modeling. Establish theoretical foundations for multi- the development of multifunctional structures used in advanced space system	such as composites, high-temper on systems. Explore synergistic ures. Explore nanomechanics to iltifunctional mechanics, including ns such as microsatellites and mi	rature alloys, and ceramic matrix combinations of information bridge the gap between continuum ng nonlinear behavior, to enable cro-vehicles.
(U)	\$4,970	Conduct research into structural and material aspects of high-cycle metal fat for predictive computer simulation of structural response. Research metal fat turbine blades and the interaction of blade motion with fluid mechanics. Stu in a timely and cost-efficient manner. Develop techniques to analyze vehicle Force weapon systems.	igue and other aging mechanism tigue-generation due to vibration dy material science to identify a e integrity and significantly incre	s of aircraft. Develop techniques of jet engine compressor and nd mitigate material degeneration ase the structural longevity of Air
(U)	\$4,068	Conduct structural mechanics research to examine innovative adaptive struct multi-mission uninhabited air vehicles. Evaluate the behavior of distributed performance prediction of aerospace systems. Research predictive techniqu high-speed aerodynamics characteristic of uninhabited air vehicles. Continu micro-scale structures to enable micro-electro-mechanical systems (MEMS) structures).	ture concepts for deployment of sensor and actuator systems to it thes capable of modeling the inter the investigating the mechanical a that can sense environments and	space-based systems and mprove the design and action of structural motion with nd dynamic behavior of I respond accordingly (smart
(U)	\$11,439	Total		
(U)	FY 2003 (\$ in Thousa	<u>nds)</u>		
(U)	\$2,495	Research mechanics of advanced materials to accelerate their use as compose Results will have direct application in aerospace vehicles, turbine engines, sp synergistically combine multiscale modeling and information technology to nanomechanics which transitions between continuum mechanics and atomise behavior to design multifunctional materials and structures used in advanced	ites, high-temperature alloys, an pace systems, and weapons syste design new materials and structu tic modeling. Apply multifuncti l aerospace systems such as micr	d ceramic matrix composites. ms. Develop methods to rres. Establish foundations of onal mechanics with nonlinear o-satellites and micro-vehicles.
(U)	\$5,109	Conduct research into the structural and material aspects of high-cycle metal fundamental computer simulations to predict structural response to assorted compressor and turbine blades and blade motion/fluid flow coupling. Study	l fatigue and other aging mechan stimuli. Explore metal fatigue-g material science to quickly and	isms of aircraft. Develop eneration caused by vibration of inexpensively identify and mitigate
Р	Project 2302	Page 9 of 47 Pages		Exhibit R-2A (PE 0601102F)

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) February 2002							
BUD0 01 ·	GET ACTIVITY - Basic Researc	n Sciences	PROJECT 2302					
(U)	A. Mission Descript	ion Continued						
(U)	FY 2003 (\$ in Thous	ands) Continued material degeneration and degredation. Develop novel system techniques to analyze vehicle int Air Force weapon systems.	egrity to significantly increase	e the robustness of				
(U)	\$4,277	Conduct structural mechanics research to examine innovative adaptive structure concepts for de multi-mission unmanned aerial vehicles (UAV). Investigate the behavior of distributed sensor a performance characterization of aerospace systems. Develop models to predict the interaction b aerodynamics characteristic of UAVs. Exploit the mechanical and dynamic behavior of micro-capabilities in micro-electro-mechanical systems (MEMS) and nano-electro-mechanical systems	ployment of space-based system and actuator systems to impro- between structural motion and and nano-scale structures to a s.	ems and ve the design and high-speed achieve exceptional				
(U)	\$11,881	Total						
(U)	<u>B. Project Change S</u> Not Applicable.	Summary						
(U) (U) (U) (U) (U) (U) (U)	C. Other Program H Related Activities: PE 0602102F, Mater PE 0602201F, Aeros PE 0602202F, Huma PE 0603211F, Aeros PE 0602203F, Aeros	Funding Summary (\$ in Thousands) als. pace Flight Dynamics. n Effectiveness Applied Research. pace Structures. pace Propulsion.						
(U)	<u>D. Acquisition Strat</u> Not Applicable.	egy						
(U) (U)	E. Schedule Profile Not Applicable.							
F	Project 2302	Page 10 of 47 Pages	Exhibit R-2A	A (PE 0601102F)				

	RDT&E	E BUDGET ITEM JU	STIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
виро 01 -	BET ACTIVITY Basic Research	1			PE NUMBE	r and title 2F Defer	nse Rese	arch Sci	ences		PROJECT 2303
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2303	Chemistry		25,852	28,806	29,578	29,904	31,023	31,621	32,218	Continuing	TBD
(U)	J) <u>A. Mission Description</u> Chemistry 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 lasers; the infrared, optical, and radar signatures of reaction products and intermediates; and the synthesis of new chemical propellants. Critical research topics include: novel synthesis and characterization of lower cost, higher performance functional and structural materials, electronics, and photonic materials; nano-structures; electromagnetic and conventional weaponry; and propellants. 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 approximately advanted and an electronic devices and and surface and interfacial existing.										
(U) (U)	<u>FY 2001 (\$ in Thousa</u> \$11,434	ands) Performed molecular dynamic flow, and developed predictiv methods for predicting molec extreme environments. Exam materials for rocket propellan	cs and theory re tools for d ular-level er nined the use ts and novel	etical chemis esigning nev ergy transfe of molecula chemical la	stry research w materials a r and chemio ar nano-clust ser systems.	to identify a and processe cal reactivity ers for use a	and predict to s for advanc v to simulate s catalysts a	echniques to ed propellar signatures a nd sensors.	control mol ts and high- nd interactio Developed 1	ecular reacti energy laser ons of aerosp new high ene	vity and energy s. Evaluated bace vehicles in brgy density
(U)	J) \$8,686 Conducted polymer chemistry research to improve fundamental understanding of chemical structures and processing conditions for advanced polymeric materials that significantly improve aircraft and spacecraft performance and life-spans. Improved spectral sensitivity of photo refractive polymers for crucial infrared applications. Investigated polymer coatings to enable smart skins and advanced sensors for air and space weapon systems. Evaluated the stability of functional polymers in space environments to enhance survivability of vehicles exposed to space radiation. Continued to seek fundamental knowledge to formulate materials that have optical transitions suitable for highly efficient optical limiting properties.										
(U)	\$5,732	Studied surface science to inv air and space systems and for performance, reduce maintena	restigate the formulation ance, and ind	chemistry of of novel lub crease the lo	f surface pro pricants. Co ngevity of ai	cesses for ac ntinued inve r and space	ccurate detect stigation of s systems. De	tion and pre surface chen eveloped pre	vention of c nical process dictive and e	orrosion and ses and struc experimental	degradation of tures to enhance models for
Р	roject 2303			Page	11 of 47 Pag	ges			Ex	hibit R-2A	(PE 0601102F)

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002
вирс 01 -	BET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT 2303
(U)	A. Mission Description	on Continued	
(U)	FY 2001 (\$ in Thousa	nds) Continued molecular lubrication in high-temperature, high-wear environments. Explored the reactions and mechanisms aircraft from corrosion. Examined surface structures with enhanced energy-densities for significantly impro- and delivery.	s for protection of aluminum ved weapon system energy storage
(U)	\$25,852	Total	
(U)	FY 2002 (\$ in Thousa	<u>nds)</u>	
(U)	\$11,801	Perform molecular dynamics and theoretical chemistry research to identify and predict techniques to control flow, and develop predictive tools for designing new materials and processes for advanced propellants and hi understanding of mechanisms of using ion and plasma chemistry to reduce drag and/or enhance combustion monopropellants for satellite and rocket applications. Determine the gain and loss mechanisms in chemical l higher powers. Identify inputs required to model chemically reacting flows in rocket plumes. Develop theor properties of structural materials.	molecular reactivity and energy igh-energy lasers. Seek Synthesize novel chemical aser systems to permit operation at retical methods to predict
(U)	\$9,120	Conduct polymer chemistry research to improve fundamental understanding of chemical structures and proce advanced polymeric materials for significantly improved Air Force systems performance and life-spans. Exp organic materials that will enable protection of Air Force personnel and sensors from agile lasers. Investigat thermal and mechanical properties of polymers for lightweight aerospace structures. Devise controls of nano photonic and electronic functions.	essing conditions to develop plore chemistry concepts based on e nanocomposites to improve ostructure assembly to attain new
(U)	\$5,903	Study the chemistry of surface and interfacial processes for accurate detection and prevention of corrosion ar systems, and development and design of novel lubricants. Develop new long-life, low-friction surface struct space environments. Examine environmentally compliant nanostructured coating systems for corrosion prote Investigate novel three-dimensional surface nanostructures for sensor, optical, and power applications. Examine with enhanced energy densities for significantly improved weapon system energy storage and delivery. Developmentods for surface and interfacial chemical processes.	nd degradation of air and space ures and coatings for terrestrial and action of aluminum aircraft. ine nanoscale surface structures elop theoretical and predictive
(U)	\$1,982	Conduct research in chemical synthesis and detection techniques, chemical theory, and modeling and simular in new fuels and rocket propellants that are environmentally benign, have reduced signatures, and are less ser Investigate applications of these potential fuels in flight vehicles to study the benefits of increasing mass of p increasing the lifetime of satellites on orbit. Study application of any potential fuels breakthroughs to the de	tion that will lead to breakthroughs nsitive to accidental detonations. payloads put into space and evelopment of hydrocarbon-fueled
Р	roject 2303	Page 12 of 47 Pages	Exhibit R-2A (PE 0601102F)

	RDT&E	BUDGET ITEM JUSTIFICATION S	SHEET (R-2A Exhibit)	DATE February 2002
вира 01 -	BET ACTIVITY Basic Research		PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT S 2303
(U)	A. Mission Description	on Continued		
(U)	FY 2002 (\$ in Thousa	nds) Continued		
(U)	\$28,806	scramjets and combined-cycle engines for space applic Total	cations.	
ധ	FY 2003 (\$ in Thousa	nds)		
(U)	\$12,135	Conduct molecular dynamics and theoretical chemistry flow. Results will enable development of next generat energetic propellants and high-energy lasers. Explore between aerospace systems and the space environment propulsion and munitions. Develop and validate theoret chemically reacting flows associated with hypersonic v chemical laser systems.	v research to identify and predict techniques to control ion predictive tools for designing new materials and puses of ion and plasma chemistry for flow control app . Investigate concepts of reactive energetic nano-struc- etical methods to predict and design behavior and propre- vehicles. Research new chemical sources of electronic	molecular reactivity and energy rocesses for advanced, super lications. Model interactions tures for applications to perties of nano-structures. Model excited states needed to fuel
(U)	\$9,377	Conduct polymer chemistry research to improve funda develop advanced polymeric materials. Research findi Explore magnetic, conductive, and optical properties o Investigate biologically inspired polymer concepts to a structures. Explore molecular conformational changes	mental understanding of chemical structures, reactivity ings aimed at significantly improving Air Force system f coating materials to achieve smart skin concepts with chieve previously unattainable material properties and to achieve controllable mechanical actuation in polyn	y, and processing conditions to as performance and life-spans. a on-demand tunable properties. complex supramolecular peric materials.
(U)	\$6,066	Investigate the chemistry of surface and interfacial pro space systems. Explore physical properties of novel lu and space environments. Research novel three-dimens nano-scale surface structures with enhanced energy-de predictive methods for surface and interfacial chemical	cesses for accurate detection and prevention of corrosi bricants. Create new low-friction long-life coatings a ional surface nano-structures for sensor, optical, and p nsities for better weapon system energy storage and de processes.	on and degradation of air and nd surface structures for terrestrial power applications. Probe elivery. Develop theoretical and
(U)	\$2,000	Research novel chemical synthesis and detection techn breakthroughs in new fuels and rocket propellants that sensitive to accidental detonations. Identify and invest of increasing mass of payloads put into space and incre breakthroughs to the development of hydrocarbon-fuel	iques, chemical theory, and modeling and simulation f are more energetic, are environmentally benign, have igate applications of these potential fuels in flight veh easing the lifetime of satellites on orbit. Study applica ed scramjets and combined-cycle engines for space ap	focused on revolutionary reduced signatures, and are less icles so as to enhance the benefits tion of any potential fuels plications.
(U)	\$29,578	Total		
P	roject 2303	Page 1	3 of 47 Pages	Exhibit R-2A (PE 0601102F)

	RDT&E BUDGET ITEM JUSTIFICAT	DATE February 2002	
BUD 01 ·	GET ACTIVITY - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT 2303
(U)	B. Project Change Summary Not Applicable.		
(U) (U) (U) (U) (U) (U)	<u>C. Other Program Funding Summary (\$ in Thousands)</u> Related Activities: PE 0602102F, Materials. PE 0602203F, Aerospace Propulsion. PE 0602601F, Space Technology. PE 0602602F, Conventional Munitions.		
(U)	<u>D. Acquisition Strategy</u> Not Applicable.		
(U) (U)	E. Schedule Profile Not Applicable.		
F	Project 2303	Page 14 of 47 Pages	Exhibit R-2A (PE 0601102F)

Γ	RDT&I	E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
вира 01 -	BET ACTIVITY Basic Research	١			PE NUMBE	R AND TITLE 2F Defer	nse Rese	arch Sci	ences		PROJECT 2304
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2304	Mathematical and (Computer Sciences	32,061	35,079	33,169	34,879	34,576	35,253	35,923	Continuing	TBD
(U)	(U) <u>A. Mission Description</u> Mathematical and computer sciences research develops novel techniques for mathematical modeling and simulation, algorithm development, complex systems control and innovative analytical and high performance computing methods for aerospace systems. Basic research provides fundamental knowledge enabling improved performance and control of aerospace systems through accurate models and computational tools, artificial intelligence, and improved programming techniques and theories. The primary areas of research investigated by this project are dynamics and control, physical mathematics and applied analysis, computational mathematics optimization and discrete mathematics, signals communication and surveillance, as well as complex systems and software.					systems control, improved chniques and al mathematics,					
(U) (U)	FY 2001 (\$ in Thousands)\$6,603Performed dynamics and control research to develop new techniques for design and analysis of control systems to significantly enhance capabilities and performance of aerospace vehicles. Developed modeling, identification, and control capabilities necessary for the integrated control of vehicle aerodynamics and engine performance. Continued creating control algorithms for optical components to handle extreme atmospheric turbulence encountered in target acquisition by deployable laser platforms. Expanded active and adaptive control algorithms to					enhance the integrated dle extreme algorithms to					
(U)	\$6,576	Conducted computational sys technologies to devise critical knowledge base construction Refined distributed, automatic	tems, software ar l software ar from multip	are, artificial ad computati le, variant so panagement	intelligence onal systems ources and an approaches f	, and softwa s for battlesp utomatic kno or advanced	re reliability pace informa pwledge acqu methods of	research to tion manage uisition to er mobile ager	investigate te ement. Cont thance Air F	unique comp inued autom Force intellig	uter atic large ence operations.
(U) (U)	 \$6,461 \$6,461 Conducted physical mathematics, applied analysis, and electromagnetics research to devise accurate models of physical phenomena to enhance controls and signal processing techniques. Investigated the feasibility of coherently propagating short laser pulses through the air for superior accuracy in laser-guided munitions. Predicted nonlinear optical effects within semiconductor lasers and through other nonlinear optical media for applications in laser beam control and stability. Formulated optimal electromagnetic wave propagation/scattering codes to provide accurate and timely target recognition. Devised methods to penetrate tree cover and recognize targets. \$4,675 \$4,675 Studied optimization and discrete mathematics to devise advanced mathematical methods for solving complex problems in logistics, engineering design, and strategic planning for battlespace information management. Expanded transportable agent technology to support 					nena to enhance air for superior r optical media provide accurate stics, to support					
P	roject 2304	defensive information warfare	e application	is and formu	lated real-tir	ne problem	solving strat	egies to sup	port dynami	c planning ar	ad execution.

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)							
BUDO 01 -	GET ACTIVITY - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT					
(U)	A. Mission Description	on Continued						
(U) (U)	<u>FY 2001 (\$ in Thousa</u> \$3,493	nds) Continued Performed computational mathematics research to devise unique simulations and designs of advanced Air For integrating new multidisciplinary design optimization strategies with high-order, time-accurate solvers for su aircraft wings, and other aerospace components. Devised methods to reduce computation time for chemical days. Investigated failure modes of bonded composite materials by inserting novel computational methods i	orce systems. Continued operior design of jet engines, laser simulations from months to nto mission support software tools.					
(U) (U)	\$2,609 \$1,644	Studied signals communication and surveillance to expand quantitative methodologies that extend the capab and networked communications systems, and strengthens performance of surveillance and targeting function human-assisted sensing/response platforms. Investigated irreducible expansions of signals, soft thresholding coding in wireless communication to achieve major improvements in cost versus performance trade-offs. Ex theory, functional analysis techniques, and information theory to eliminate current limits of sensing and com Researched the mathematical foundations of external aerodynamics to develop fundamental knowledge of ba	ility of critical mobile, wireless, as through autonomous and g, and efficient source-channel spanded probabilistic process munication system performance. asic fluid dynamics and					
(U)	\$32,061	plasma-aerodynamics to predict and control supersonic and hypersonic flows over combat maneuvering fligh solvers for optimal design of aircraft wings and novel aerospace components. Refined plasma-aerodynamic design of superior aerospace vehicles. Total	ht vehicles. Devised accurate flow optimization techniques to enable					
(U)	FY 2002 (\$ in Thousa	nds)						
(U)	\$6,950	Perform dynamics and control research to develop new techniques for design and analysis of control systems capabilities and performance of aerospace vehicles. Expand program on cooperative control in dynamic, une with applications to swarms of smart munitions, unmanned vehicles, and constellations of small satellites. E control of nonequilibrium behavior of complex, unsteady fluid systems (chemically reacting flows) with app materials processing.	s to significantly enhance certain, adversarial environments Develop new techniques for the lications to combustion and					
(U)	\$6,950	Conduct research in complex systems and software, artificial intelligence, automatic knowledge acquisition; knowledge bases to allow rigorous construction of highly complex battlefield information systems. Identify and mobile agents for next generation information systems. Conduct research in information operations, inc security, mobile code security, protected execution, and dynamic, adaptive intrusion detection for protection infosphere systems and networks.	study high performance advanced techniques in intelligent luding support for language-based of future battlespace and					
(U)	\$6,618	Conduct physical mathematics/applied analysis and electromagnetics research to devise accurate models of p	physical phenomena to enhance					
Р	Project 2304	Page 16 of 47 Pages	Exhibit R-2A (PE 0601102F)					

	RDT&E	DATE February 2002							
виро 01 -	GET ACTIVITY • Basic Research	PE NUMBER AND TITLE 0601102F Defense R	lesearch Science	PROJECT S 2304					
(U)	A. Mission Descripti	on Continued							
(U)) FY 2002 (\$ in Thousands) Continued controls and signal processing techniques. Investigate the feasibility of coherently propagating short laser pulses through the air for superior accuracy in laser-guided munitions. Predict nonlinear optical effects within semiconductor lasers and through other nonlinear optical media for applications in laser beam control and stability. Formulate optimal electromagnetic wave propagation/scattering codes to provide accurate and timely target recognition. Evaluate methods to penetrate tree cover and recognize targets with wide band radar. Investigate feasibility of								
(U)	\$4,634	Study optimization and discrete mathematics to devise advanced mathematical methods design, and strategic planning for battlespace information management. Expand algor the time constraint of military operations. Develop techniques for hierarchical model and complexity, to reflect time and computational constraints.	ods for solving complex orithmic research which j l building to accommoda	problems in logistics, engineering produces a feasible solution within ate multiple levels of aggregation					
(U)	\$3,640	Perform computational mathematics research to devise unique simulations and design multidisciplinary design optimization strategies with high-order, time-accurate solver munitions, and other aerospace components. Investigate efficient methods to quantif models. Continue devising methods to reduce computation time for chemical simulational dynamics simulations, munition penetration simulations, and ground-based image rec	ns of advanced Air Force rs for superior design of fy uncertainty in non-lin tions from months to day construction.	e systems. Integrate new jet engines, aircraft wings, ear multidisciplinary design ys. Improve algorithms for plasma					
(U)	\$2,649	Study signals communication and surveillance to expand quantitative methodologies communications systems, and strengthen the performance of surveillance and targetin coding in wireless communication through technical advances such as optical transmit theory to achieve higher information rates and greater reliability under stringent milit as super-resolution imaging and trellis-coded modulation.	that extend the capabilit ng functions. Improve th ission. Continue researc ary covertness constrain	y of critical mobile, networked e efficiency of source-channel th in probabilistic and analytic ts. Develop promising areas such					
(U)	\$1,982	Construct quantum computer devices that enable atomic level computing a million tin and test quantum computing algorithms and architectures enabling fast, accurate solu need for multiple design iterations and prototype testing. Develop scalable quantum characterization.	mes faster than today's s tions of complex fluid d computers for automatic	ilicon chip. Design, implement, ynamics problems eliminating the target recognition and target					
(U)	\$1,656	Explore mathematical and computational methods of external aerodynamics associate aerodynamics algorithms to include magneto hydrodynamic (MHD) augmentation of the effects of dynamic aero structural tailoring during combat maneuvers on end-gam boundary layer transition on transatmospheric vehicles to reduce heat transfer and vis	ed with hypersonic wear complete scramjet engine targeting. Computations cous drag to enable long	oon release. Expand plasma nes. Computationally investigate onally explore hypersonic g-range, high-payload hypersonic					
Р	Project 2304	Page 17 of 47 Pages		Exhibit R-2A (PE 0601102F)					

	RDT&E	BUDGET ITEM JUSTIFICATION S	HEET (R-2A Exhibit)	DATE February 2002
виро 01 -	BET ACTIVITY Basic Research		PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT
(U)	A. Mission Description	on Continued		
(U)	FY 2002 (\$ in Thousa	nds) Continued		
(U)	\$35,079	Total		
(U)	FY 2003 (\$ in Thousa	nds)		
(U)	\$7,131	Perform dynamics and control research to develop new significantly enhance capabilities and performance of a uncertain, adversarial environments with applications to small satellites. Explore means to improve control of m with applications to combustion and materials processin controller design for UAVs, smart munitions, nondestru analyze biological processes for adaptation to aerospace	techniques for design and analysis of control systems erospace vehicles. Focus of the research is on cooper o swarms of smart munitions, unmanned aerial vehicle ionequilibrium behavior of complex, unsteady fluid sy ng. Foster advances in image processing and sensor to active testing of aging or stealth aerospace vehicles. If e systems.	A. Research findings will ative control in dynamic, es (UAVs), and constellations of estems (chemically reacting flows) echnology that can be utilized in Design computational models to
(U)	\$7,131	Conduct research in complex systems and software, art bases to allow rigorous construction of highly complex operations, including support for language-based secur for protection of future battlespace/infosphere systems (10,000,000+ axioms) knowledge bases to provide deep	ificial intelligence, automatic knowledge acquisition, battlefield information systems. Explore methods to ity, mobile code security, protected execution, and dyn and networks. Develop new computational technique b, adaptive, expert decision support to battlefield com	and high performance knowledge enhance research in information namic, adaptive intrusion detection s/software in extremely large manders.
(U)	\$6,799	Conduct research in physical mathematics and applied enhance the fidelity of simulations and predictability of the air in relationship to the superior accuracy of laser g optical effects within semiconductor lasers and nonline to provide accurate and timely target recognition. Eval Study feasibility of designing reconfigurable warheads internal stores released from transonic platforms.	analysis and in electromagnetics to develop accurate r f devices. Investigate the properties of coherently pro- guided munitions and electronic warfare. Develop alg ar optical media. Formulate optimal electromagnetic uate methods to penetrate tree cover with wide band r by suitable placement/time of microdetonators. Pursu	nodels of physical phenomena to pagating short laser pulses through orithms to simulate nonlinear wave propagation/scattering codes adar to recognize and track targets. the description of dynamics of
(U)	\$4,809	Conduct research in optimization and discrete mathema problems in logistics, engineering design, and strategic algorithms those that produce a feasible, but not nece for various urgent Air Force problems such as target tra	atics to validate and further advance mathematical met /tactical planning for battlespace information manager essarily optimal, solution. Examine new modeling tec acking, mobilization planning, and manufacturing.	thods for solving complex ment. Evaluate 'anytime' hniques and computer algorithms
Р	roject 2304	Page 1	8 of 47 Pages	Exhibit R-2A (PE 0601102F)

	RDT&E	DATE February 2002							
BUDC 01 -	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT S 2304						
(U)	A. Mission Description	on Continued							
(U) (U)	 FY 2003 (\$ in Thousands) Continued \$4,478 Perform computational mathematics research to create unique simulations and designs of advanced Air Force systems. Devise means to integrate new multidisciplinary design optimization strategies with high-order, time-accurate solvers in order to design superior jet engines, aircraft wings, munitions, and other aerospace components. Develop new algorithms for unsteady reactive flow, munition penetration and fragmentation, and plasmadynamics for directed energy weapons. Develop quantum computing algorithms, architectures, and implementations 								
(U)	\$2,821	to enable exponential improvements in speed, accuracy, and fidelity of fluid dynamics simulations, signal pro- Investigate signals communication and surveillance to expand the capability of critical mobile, networked co- surveillance/reconnaissance and targeting systems through examination of fundamental principles governing include linear operator theory, generalized functions and probability, harmonic methods, and asymptotic exp encoding methods for robust wireless communication using optical transmission phenomenology. Develop a the domain of applicability of self learning, trial and error (heuristic) methods such as super-resolution imagi- higher information rates and higher reliability of communications.	ocessing, and data mining. ommunications, and signal analysis. Areas of study ansions. Explore source-channel a rigorous basis for and delineate ng. Research technologies with						
(U)	B. Project Change Si	immary							
(-)	Not Applicable.								
(U) (U) (U) (U) (U) (U) (U)	C. Other Program Fr Related Activities: PE 0602201F, Aerosp PE 0602203F, Aerosp PE 0602602F, Conver PE 0602702F, Comma PE 0603789F, C3I Ad	ace Flight Dynamics. ace Propulsion. tional Munitions. and, Control, and Communications. vanced Development.							
(U)	D. Acquisition Strate Not Applicable.	<u>ey</u>							
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.								
Р	roject 2304	Page 19 of 47 Pages	Exhibit R-2A (PE 0601102F)						

	RDT&I	E BUDGET ITEM JU	STIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDGET ACTIVITY PE NUMBER AND TITLE 01 - Basic Research Cience: 0601102F Defense Research Science:								ences		PROJECT 2305	
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2305	Electronics		23,444	27,498	24,565	26,494	26,305	26,803	27,300	Continuing	TBD
(U)	U) <u>A. Mission Description</u> Electronics basic research aims to enhance fundamental understanding of electronic materials, devices, and systems to advance Air Force operational capabilities in directed energy weapons, stealth technologies, electronic countermeasures, information and signal processing, and communications. It enables development of electronic processes to model and predict performance of electronic materials, devices, and systems for power generation, optical signal processing, radiation effects, and high-speed signal processing. The goals are to firmly control the complexity and reliability of electronic systems, increase data transmission and information processing speeds of Air Force systems, and improve the security and reliability of electronic information. The primary areas of research investigated by this project are space electronics, optoelectronic materials, optoelectronic information processing, optoelectronic systems.					capabilities in opment of idiation effects, information by this project olids.					
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$7,658	ands) Performed space electronics r and weight of space platforms bandgap semiconductor mater radiation effects on electronic	esearch to e s. Continue rials ideal fo	xamine milit d characteriz r radio frequ	tary unique l ting surface a tency (RF) p erials and de	ow-power and and interface ower source vised metho	nd complem e states to pro s and high-to	entary electro event electro emperature o	onic circuits nic device d operations. 1	s to greatly re legradation. Identified fun	educe the size Explored wide ndamental
(U)	\$7,572	Conducted optoelectronic mat achieve surveillance dominan laser materials to detect, degra surveillance, and to obtain tar	terials reseat ce of the bat ade, or blind get signatur	rch to invest ttlespace. In an adversar	igate detection wented unique y's detection l ranges appr	on of optical ue materials capabilities copriate for c	radiation from to protect cross. Created n	om far infran itical optical ew detectors recognition.	red to the ult systems fro for characte	raviolet spec om enemy atterization of t	etroll etral range to eack. Devised he battlespace,
(U)	\$4,457	Studied optoelectronic inform critical communication system refine complex semiconducto communication and parallel si military operations.	aation proces n accuracy, r structures ignal proces	ssing to expl speed, and d for imaging sing for enal	ore develop ata storage. and commur bling secure	nent and app Investigated nication syste satellite com	blication of c high bandw ems. Create munication	optoelectronividth, multi-vidth, multi-vidth	c materials wavelength terials for m reased data	and devices modulators a aximum hig transfer spee	to enhance nd detectors to h-bandwidth ds required for
(U)	\$3,757	Performed quantum electronic sensing communications, sign tapes and cables for enhanced	c solids rese nal processin power gene	arch to inves ag, and super eration and s	stigate super rior data stor torage on Ai	conducting, age capabilit r Force spac	magnetic, ar ties. Created e platforms	nd nanoscopi 1 high-curren and directed	c materials nt, high-temp energy wea	and devices a perature superature superat	for advanced erconducting lated innovative
Р	roject 2305			Page	20 of 47 Pag	ges			Ex	hibit R-2A	(PE 0601102F)

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002
вирс 01 -	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT S 2305
(U)	A. Mission Description	on Continued	
(U)	FY 2001 (\$ in Thousa	nds) Continued	
(U)	\$23,444	approaches to measure active corrosion in aircraft structures to extend performance lifespan. Total	
(U)	FY 2002 (\$ in Thousa	<u>nds)</u>	
(U)	\$7,991	Perform space electronics research to examine military unique low-power and complementary electronic circuits weight of space platforms. Study the effects of intense RF pulses on electronic circuits and systems. Devise interface states from degrading electronic device performance. Explore wide bandgap semiconductor materia power sources and high-temperature operations. Identify fundamental radiation effects on electronic and sem methods to prevent space system degradation or destruction.	uits to greatly reduce the size and means to prevent surface and als as promising candidates for RF niconductor materials and devise
(U)	\$7,762	Conduct optoelectronic materials research for detection and emission of optical radiation from far infrared to achieve spectral dominance of the battlespace. Investigate new non-linear optical materials to protect critical and access laser wavelengths and power not available with solid state or semiconductor lasers. Study basic metficiency and uncooled operation of lasers and detectors. Formulate laser materials to degrade or blind an accepabilities. Investigate fast multiband detectors for characterization of the battlespace, surveillance, target t Study unique properties available from nanoscale combinations of optoelectronic materials.	the ultraviolet spectral range to optical systems from laser fire, nechanisms that limit the dversary's detection and tracking racking, and target signatures.
(U)	\$4,602	Study optoelectronic information processing to explore development and application of electro-optical mater communication system accuracy, speed, and data storage. Investigate high bandwidth, multi-wavelength mo and refine complex semiconductor structures for imaging and communication systems. Create optical materi- communication and parallel signal processing. Investigate the use of new optical materials for enabling secur- increased data transfer speeds required for military operations.	ials and devices to enhance critical dulators and detectors to develop als for maximum high-bandwidth re satellite communications and
(U)	\$3,875	Perform quantum electronic solids research to investigate superconducting, magnetic, and nanoscopic materi sensing communications and signal processing, and superior data storage capabilities. Improve high-tempera superconducting tapes and cables for enhanced storage and power generation on Air Force space platforms a Develop new techniques to quantify active corrosion in aircraft structures to increase lifespan. Investigate ne materials with sufficient mechanical strength for utilization in aircraft with higher electric workloads	als and devices for advanced ature, high-current nd directed energy weapons. w high-temperature magnetic
(U)	\$1,981	Conduct research addressing the scientific barriers to miniaturization of components enabling much lighter, r microsatellites and nanosatellites. Research nanopropulsion and power schemes, smart skins, radiation harde	nore compact, highly capable ening and quantum effect
Р	roject 2305	Page 21 of 47 Pages	Exhibit R-2A (PE 0601102F)

BUDGET ACTIVITY PE NUMBER AND TITLE PEOJECT 01 - Basic Research 0601102F Defense Research Sciences 2305 (U) A. Mission Description Continued EVENUME 2305 (U) A. Mission Description Continued electronics to reduce satellite cost, weight, and size each by a factor of ten. Investigate nanosatellite benefits for improving access to space, mission flexibility, case of augmentation and upgrade, and graceful degradation during end of service life. (U) \$1,287 Establish focuserd associated with system optimization and characterization. Investigate properties for establishing and regulating the narrowest beam diameter at relatively high energy. Investigate the effects and benefits derived from a wide range of isotopes provided by various liquid metal ion sources. In addition research means to enable advancing component size and weight while increasing reliability. Expand study of intense radio frequency palse effects on electronic circuits and systems. Design, fabricate, and evaluate wide bandgap semiconductor materials to achieve an unique combination of high radio frequency power output, high efficiency. Jow noise, robustness, and radiation hardness. Devise nano-salelite electronic device concepts and initiate efforts in derival ty electronic approaches to increasing spacecraft survivability. Conduct research on the interaction of systems and sensors with the space environment. Develop models to predict the effects of terrestrial and and space backgrounds and radiation normace in order to promote secure, wide bandyidh communication through the atmosphere and ionosphere as well as between satellites. (U) \$7,861 Conduct res		RDT&E	DATE February 2002	
 (U) A.Mission Description Continued (U) FY 2002 (S in Thousands) Continued electronics to reduce satellite cost, weight, and size each by a factor of ten. Investigate nanosatellite benefits for improving access to space, mission flexibility, ease of augmentation and upgrade, and graceful degradation during end of service life. (U) \$1,287 Establish focused ion beam research associated with system optimization and characterization. Investigate properties for establishing and regulating the narrowest beam diameter at relatively high energy. Investigate the effects and benefits derived from a wide range of isotopes provided by various liquid metal ion sources. In addition research means to enable advancing computing, sensing, and image processing associated with ion beam research. (U) \$27,498 Total (U) <u>FY 2003 (S in Thousands)</u> (U) <u>S27,498 Total</u> (U) <u>FY 2003 (S in Thousands)</u> (U) <u>S7,861 Conduct research on military space platform unique electronic circuits aimed at greatly reducing component size and weight while increasing reliability. Expand study of intense radio frequency pulse effects on electronic circuits and systems. Design, fabricate, and evaluate wide bandgrap semiconductor materials to achieve an unique combination of high radio forquency power output, high effects of terrestrials to achieve an unique combination of systems and snors with the space environment. Develop models to predict the effects of terrestrial and space backgrounds and radiation on sensor performance in order to promote secure, wide bandwidth </u>	вира 01 -	GET ACTIVITY • Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT 2305
 <u>FV 2002 (S in Thousands) Continued</u> electronics to reduce satellite cost, weight, and size each by a factor of ten. Investigate nanosatellite benefits for improving access to space, mission flexibility, ease of augmentation and upgrade, and graceful degradation during end of service life. S1,287 Establish focused ion beam research associated with system optimization and characterization. Investigate properties for establishing and regulating the narrowest beam diameter at relatively high energy. Investigate the effects and benefits derived from a wide range of isotopes provided by various liquid metal ion sources. In addition research means to enable advancing computing, sensing, and image processing associated with ion beam research. S27,498 Total <u>FV 2003 (S in Thousands)</u> S8,883 Conduct research on military space plafform unique electronic circuits aimed at greatly reducing component size and weight while increasing reliability. Expand study of intense radio frequency pulse effects on electronic circuits and systems. Design, fabricate, and evaluate wide bandgap semiconductor materials to achieve an unique combination of high radio frequency power output, high efficiency, low noise, robustness, and radiation hArchess. Devise nano-satellite electronic device concepts and initiate efforts to identify electronic approaches to increasing spacecraft survivability. Conduct research on the interaction of systems and sensors with the space environment. Develop models to predict the effects of terrestrial and space backgrounds and radiation on sensor performance in order to promote secure, wide bandwidth communication through the atmosphere and iononophere as well as between satellives. S7,861 Conduct optoelectronic materials research for detection and emission of optical radiation from the far inf	(U)	A. Mission Description	on Continued	
 (U) \$1,287 Establish focused on beam research associated with system optimization and characterization. Investigate properties for establishing and regulating the narrowest beam diameter at relatively high energy. Investigate the effects and benefits derived from a wide range of isotopes provided by various liquid metal ion sources. In addition research means to enable advancing computing, sensing, and image processing associated with system optimization and characterization. Investigate properties for establishing and regulating the narrowest beam diameter at relatively high energy. Investigate the effects and benefits derived from a wide range of isotopes provided by various liquid metal ion sources. In addition research means to enable advancing computing, sensing, and image processing associated with ion beam research. (U) \$27,498 Total (U) <u>FY 2003 (\$ in Thousands</u>) (U) \$8,883 Conduct research on military space platform unique electronic circuits and systems. Design, fabricate, and evaluate wide bandgap semiconductor materials to achieve an unique combination of high radio frequency power output, high efficiency, low noise, robustness, and radiation hardness. Devise nano-satellite electronic device concepts and initiate efforts to identify electronic approaches to increasing spacecraft survivability. Conduct research for detection and ensistion of systems and sensors with the space environment. Develop models to predict the effects of terrestrial and space backgrounds and radiation from the far infrared to ultraviolet spectral range to achieve spectral dominance of the battlespace. Investigate unique non-linear optical materials to protect critical optical systems from laser radiation. Assess basic electronic materials to improve the efficiency and reduce the cooling requirements of lasers and detectors. Synthesize laser materials to degrade or bild and adversary's detection and tracking capabilities. Create fast multiband detectors for characterization o	(U)	FY 2002 (\$ in Thousa	nds) Continued electronics to reduce satellite cost, weight, and size each by a factor of ten. Investigate nanosatellite benefits mission flavibility area of sugmentation and ungrade, and greatful degradation during and of service life	for improving access to space,
 (U) \$27,498 Total (U) <u>FY 2003 (\$ in Thousands</u>) (U) \$8,883 Conduct research on military space platform unique electronic circuits aimed at greatly reducing component size and weight while increasing reliability. Expand study of intense radio frequency pulse effects on electronic circuits and systems. Design, fabricate, and evaluate wide bandgap semiconductor materials to achieve a unique combination of high radio frequency power output, high efficiency, low noise, robustness, and radiation hardness. Devise nano-satellite electronic device concepts and initiate efforts to identify electronic approaches to increasing spacecraft survivability. Conduct research on the interaction of systems and sensors with the space environment. Develop models to predict the effects of terrestrial and space backgrounds and radiation on sensor performance in order to promote secure, wide bandwidth communication through the atmosphere and ionosphere as well as between satellites. (U) \$7,861 Conduct optoelectronic materials research for detection and emission of optical radiation from the far infrared to ultraviolet spectral range to achieve spectral dominance of the battlespace. Investigate unique non-linear optical materials to protect critical optical systems from laser radiation. Assess basic electronic mechanisms to improve the efficiency and reduce the cooling requirements of lasers and detectors. Synthesize laser materials to degrade or blind an adversary electronia nut tracking capabilities. Create fast multiband detectors for characterization of the battlespace, surveillance, target tracking, and target signatures. Develop nano-fabrication denology for unique optoelectronic materials for use in high bandwidth, multi-wavelength modulators and detectors for secure satellite imaging and faster data transfer rate communication systems. Explore optoelectronic nanotechnologies: nanophotonics, nanoelectronics, and nanosensors and opportunities in terahertz technologies.	(U)	\$1,287	Establish focused ion beam research associated with system optimization and characterization. Investigate p regulating the narrowest beam diameter at relatively high energy. Investigate the effects and benefits derived provided by various liquid metal ion sources. In addition research means to enable advancing computing, se associated with ion beam research.	roperties for establishing and I from a wide range of isotopes nsing, and image processing
 (U) <u>FY 2003 (\$ in Thousands)</u> (U) \$8,883 Conduct research on military space platform unique electronic circuits aimed at greatly reducing component size and weight while increasing reliability. Expand study of intense radio frequency pulse effects on electronic circuits and systems. Design, fabricate, and evaluate wide bandgap semiconductor materials to achieve an unique combination of high radio frequency power output, high efficiency, low noise, robustness, and radiation hardness. Devise nano-satellite electronic device concepts and initiate efforts to identify electronic approaches to increasing spacecraft survivability. Conduct research on the interaction of systems and sensors with the space environment. Develop models to predict the effects of terrestrial and space backgrounds and radiation on sensor performance in order to promote secure, wide bandwidth communication through the atmosphere and ionosphere as well as between satellites. (U) \$7,861 Conduct optoelectronic mechanisms to improve the efficiency and reduce the cooling requirements of lasers and detectors. Synthesize laser materials to degrade or blind an adversary's detection and tracking capabilities. Create fast multiband detectors for characterization of the battlespace, surveillance, target tracking, and target signatures. Develop nano-fabrication technology for unique optoelectronic information processing to explore the design, development, and application of novel optoelectronic materials for use in high bandwidth, multi-wavelength modulators and detectors for secure satellite imaging and faster data transfer rate communication systems. Explore optoelectronic nanotechnologies: nanophotonics, nanoelectronics, and nanosensors and opportunities in terahertz technologies. 	(U)	\$27,498	Total	
 (U) \$8,883 Conduct research on military space platform unique electronic circuits aimed at greatly reducing component size and weight while increasing reliability. Expand study of intense radio frequency pulse effects on electronic circuits and systems. Design, fabricate, and evaluate wide bandgap semiconductor materials to achieve an unique combination of high radio frequency power output, high efficiency, low noise, robustness, and radiation hardness. Devise nano-satellite electronic device concepts and initiate efforts to identify electronic approaches to increasing spacecraft survivability. Conduct research on the interaction of systems and sensors with the space environment. Develop models to predict the effects of terrestrial and space backgrounds and radiation on sensor performance in order to promote secure, wide bandwidth communication through the atmosphere and ionosphere as well as between satellites. (U) \$7,861 Conduct optoelectronic materials research for detection and emission of optical radiation form the far infrared to ultraviolet spectral range to achieve spectral dominance of the battlespace. Investigate unique non-linear optical materials to protect critical optical systems from laser radiation. Assess basic electronic mechanisms to improve the efficiency and reduce the cooling requirements of lasers and detectors. Synthesize laser materials to degrade or blind an adversary's detection and tracking capabilities. Create fast multiband detectors for characterization of the battlespace, surveillance, target tracking, and target signatures. Develop mano-fabrication technology for unique optoelectronic materials rod properties. (U) \$2,334 Conduct research in optoelectronic information processing to explore the design, development, and application of novel optoelectronic materials and devices to enhance critical communication system accuracy and speed. Examine complex semiconductor structures and develop optical materials for use in high bandwidth, multi-wave	(U)	FY 2003 (\$ in Thousa	<u>nds)</u>	
 (U) \$7,861 Conduct optoelectronic materials research for detection and emission of optical radiation from the far infrared to ultraviolet spectral range to achieve spectral dominance of the battlespace. Investigate unique non-linear optical materials to protect critical optical systems from laser radiation. Assess basic electronic mechanisms to improve the efficiency and reduce the cooling requirements of lasers and detectors. Synthesize laser materials to degrade or blind an adversary's detection and tracking capabilities. Create fast multiband detectors for characterization of the battlespace, surveillance, target tracking, and target signatures. Develop nano-fabrication technology for unique optoelectronic material properties. (U) \$2,334 Conduct research in optoelectronic information processing to explore the design, development, and application of novel optoelectronic materials for use in high bandwidth, multi-wavelength modulators and detectors for secure satellite imaging and faster data transfer rate communication systems. Explore optoelectronic nanotechnologies: nanophotonics, nanoelectronics, and nanosensors and opportunities in terahertz technologies. Project 2305 	(0)	\$8,88 3	reliability. Expand study of intense radio frequency pulse effects on electronic circuits and systems. Design bandgap semiconductor materials to achieve an unique combination of high radio frequency power output, he robustness, and radiation hardness. Devise nano-satellite electronic device concepts and initiate efforts to ide increasing spacecraft survivability. Conduct research on the interaction of systems and sensors with the space to predict the effects of terrestrial and space backgrounds and radiation on sensor performance in order to pro- communication through the atmosphere and ionosphere as well as between satellites.	, fabricate, and evaluate wide igh efficiency, low noise, entify electronic approaches to e environment. Develop models omote secure, wide bandwidth
 (U) \$2,334 Conduct research in optoelectronic information processing to explore the design, development, and application of novel optoelectronic materials and devices to enhance critical communication system accuracy and speed. Examine complex semiconductor structures and develop optical materials for use in high bandwidth, multi-wavelength modulators and detectors for secure satellite imaging and faster data transfer rate communication systems. Explore optoelectronic nanotechnologies: nanophotonics, nanoelectronics, and nanosensors and opportunities in terahertz technologies. Project 2305 Page 22 of 47 Pages Exhibit R-2A (PE 0601102F)	(U)	\$7,861	Conduct optoelectronic materials research for detection and emission of optical radiation from the far infrare achieve spectral dominance of the battlespace. Investigate unique non-linear optical materials to protect critic radiation. Assess basic electronic mechanisms to improve the efficiency and reduce the cooling requirement Synthesize laser materials to degrade or blind an adversary's detection and tracking capabilities. Create fast characterization of the battlespace, surveillance, target tracking, and target signatures. Develop nano-fabrication optoelectronic material properties.	d to ultraviolet spectral range to cal optical systems from laser s of lasers and detectors. multiband detectors for tion technology for unique
Project 2305 Page 22 of 47 Pages Exhibit R-2A (PE 0601102F)	(U)	\$2,334	Conduct research in optoelectronic information processing to explore the design, development, and application materials and devices to enhance critical communication system accuracy and speed. Examine complex semi optical materials for use in high bandwidth, multi-wavelength modulators and detectors for secure satellite in communication systems. Explore optoelectronic nanotechnologies: nanophotonics, nanoelectronics, and nan terahertz technologies.	on of novel optoelectronic iconductor structures and develop naging and faster data transfer rate osensors and opportunities in
	Р	roject 2305	Page 22 of 47 Pages	Exhibit R-2A (PE 0601102F)

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002					
виро 01 -	GET ACTIVITY • Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT					
(U)	A. Mission Description	on Continued						
(U) (U)	FY 2003 (\$ in Thousands) Continued\$3,930Perform quantum electronic solids research to investigate superconducting, magnetic and nanoscopic materials for advanced sensing, communications, and signal processing. Investigate superconducting quantum systems for adaptation to quantum computing and encryption. Develop high-current, high-temperature superconducting cables and tapes for enhanced power generation and storage on Air Force directed energy weapons and space platforms. Develop new high-temperature magnetic materials with sufficient mechanical strength for use in aircraft							
(U) (U)	\$1,557 \$24,565	Perform research in optoelectronic memory technologies and persistent spectral hole-burning systems for da page-oriented or holographic memory configurations in two or three dimensions. Explore capabilities to buf and quantities anticipated for multispectral devices. Develop new technogies to increase capabilities in high and processing for surveillance, target discrimination, and autonomous navigation. Total	ta storage and processing. Develop fer, store, and retrieve data at rates speed image capture, data storage					
(U)	B. Project Change St	<u>immary</u>						
(U) (U) (U) (U) (U) (U)	Not Applicable. C. Other Program Fu Related Activities: PE 0602204F, Aerospa PE 0602702F, Comma PE 0603203F, Advanc PE 0603789F, C3I Advance	unding Summary (\$ in Thousands) ace Sensors. nd, Control, and Communications. ed Aerospace Sensors. vanced Development.						
(U)	D. Acquisition Strate Not Applicable.	2Y						
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.							
Р	roject 2305	Page 23 of 47 Pages	Exhibit R-2A (PE 0601102F)					

	RDT	&E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	nry 2002
BUDGET ACTIVITY PE NUMBER AND TITLE 01 - Basic Research 0601102F Defense Research Science									ences		PROJECT 2306
	COST	(\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2306	Materials		13,621	16,355	15,004	17,574	18,464	18,791	19,122	Continuing	TBD
(U)	A. Mission Description Materials research enhances the performance, cost, and reliability of structural materials to eliminate reliability issues related to high-temperature strength, toughness, fatigue, and environmental conditions. It expands fundamental knowledge of material properties that will enable novel materials for airframe, turbine engine, and spacecraft structures. The goals of this project are to develop improved aerospace vehicle structural materials, increase the operating temperature of engine materials, and further increase thrust-to-weight ratio of engines. Basic research emphasis is on refractory alloys, inter-metallics, polymer composites, metal and ceramic matrix composites, advanced ceramics, such as alumina, silicon carbide, silicon nitride, and carbon/carbon, and in new material processing methods. The primary areas investigated by this project are ceramic and non-metallic materials, metallic materials, and organic matrix composites										
(U) (U)	<u>FY 2001 (\$ in Tho</u> \$4,429	Performed ceramic and non-realistic and non-realistic and rocket engine oxide composites and eutectic systems based on carbides for	netallic mate es and space cs for jet eng	erials researc vehicle app gine blade ap	th to examin lications. In pplications. S	e the fundan westigated c Sought funda	nentals of ve oupled therm amental know	ry-high temp nal and mech wledge to fo	perature, nor hanical stabi rmulate ultra	n-metallic ma lity of very- a-high tempe	aterials for high temperature erature materials
(U)	\$7,211	Conducted metallic materials mechanical stability of refract	research to tory metal sy	evaluate nov ystems for ve	vel metallic s ery-high tem	ystems for p perature airc	propulsion ar craft applicat	nd airframe a tions. Evalu	applications. ated tailorab	Explored the transition	hermal and -phase materials
(U)	\$1,981	Studied organic matrix composition of superior and the structures. Explored durability issues in liquid fuel mechanical and electromagne	osites to exp thermal cycl tank enviro tic propertie	and knowled ing effects o onments. Investing file	lge of polym of polymer m vestigated in per reinforce	er matrix con atrix compo novative fibe d composite	omposites an osites down t er sizing tech structures.	d increase th o cryogenic nniques to m	e strength a temperature inimize moi	nd life-span range to bet sture degrad	of air and space ter understand ation of
(U)	\$13,621	Total									
P	roject 2306			Page	24 of 47 Pag	ges			E>	hibit R-2A	(PE 0601102F)

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002
вирс 01 -	GET ACTIVITY • Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT
(U)	A. Mission Description	on Continued	
(U)	<u>FY 2002 (\$ in Thousa</u>	nds)	
(U)	\$4,743	Perform ceramic and non-metallic materials research to understand optimum strength of very-high temperatu airbreathing and rocket engines, and space vehicle applications. Study thermal and mechanical stability inter- oxide and non-oxide composites for jet engine blade applications. Advance fundamental materials knowledge temperature material systems based on carbides for rocket propulsion applications.	are, non-metallic materials for eraction of very-high temperature ge to develop ultra-high
(U)	\$7,473	Conduct metallic materials research to develop affordable and durable metallic systems for advanced engines applications. Expand investigations of thermal and mechanical stability of metal refractory alloys, intermetal temperature aircraft applications. Research tailorable transition-phase materials for superior thermal barrier metals for multifunctional space systems.	s and aerospace structural lics, and composites for very-high coatings and develop advanced
(U)	\$2,157	Perform organic matrix composites research to advance polymer matrix composite knowledge and increase t aerospace structures. Study thermal cycling effects of polymer matrix composites at cryogenic temperatures liquid fuel tank environments. Research novel fiber sizing techniques to minimize moisture degradation of r properties in glass fiber reinforced composite structures.	he life-span and strength of to improve material durability in nechanical and electromagnetic
(U)	\$1,982	Develop new mathematical and computational strategies to reduce maturity time for new materials by ~50% structural materials for aerospace systems. Explore scientific basis for computational design to reduce amou required. Develop high performance materials more affordably through synchronization of material develops design.	and to minimize the costs of new nt of costly experimentation ment and engineering system
(U)	\$16,355	Total	
(U)	FY 2003 (\$ in Thousa	<u>nds)</u>	
(U)	\$4,952	Perform ceramic and non-metallic materials research to design new materials and composites for very-high t and space applications. Optimize thermal and mechanical stability of very-high temperature oxide composite engine blade applications. Develop concepts for the application of advanced fundamental knowledge to creat systems based on carbides for rocket propulsion applications. Design and optimize multifunctional ceramic enhanced fuell cells, sensors, and actuators.	emperature, hostile environment air es and eutectics for aircraft and jet ate ultra-high temperature materials materials to enable structurally
(U)	\$7,802	Conduct metallic materials research to develop affordable and durable metallic systems for advanced enginer applications. Investigations focus on mechanical and thermal stability of composites, metal refractory alloys temperature aircraft applications. Develop functionally gradient structures for superior thermal barrier coatin	s and aerospace structural s, and intermetallics for very-high ngs. Create advanced metals for
P	roject 2306	Page 25 of 47 Pages	Exhibit R-2A (PE 0601102F)

	RDT&E	DATE February 2002	
BUDO 01 -	BET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT
(U)	A. Mission Description	on Continued	
(U)	FY 2003 (\$ in Thousa	nds) Continued	
(U)	\$2,250	multifunctional space systems. Perform organic matrix composites research to advance polymer matrix composites knowledge to increase the aerospace structural materials. Analyze effects of cyclic thermal loads on polymer matrix composites down increase durability in liquid fuel tank materials. Develop new fiber sizing techniques in glass fiber reinforce degradation of mechanical and electromagnetic properties due to moisture.	he strength and life-span of to cryogenic temperatures to d structures to minimize
(U)	\$15,004	Total	
(U)	<u>B. Project Change Su</u> Not Applicable.	mmary	
(U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Fu Related Activities: PE 0602102F, Materia PE 0603211F, Aerospa PE 0708011F, Industri PE 0602203F, Aerospa PE 0602201F, Aerospa PE 0602601F, Space T	nding Summary (\$ in Thousands) ls. Ice Structures. al Preparedness. Ice Propulsion. Ice Flight Dynamics. echnology.	
(U)	D. Acquisition Strate Not Applicable.	Σ.	
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.		
Р	roject 2306	Page 26 of 47 Pages	Exhibit R-2A (PE 0601102F)

Γ	RDT&	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002	
вира 01 -	GET ACTIVITY • Basic Researc	h			PE NUMBE 060110	PE NUMBER AND TITLE 0601102F Defense Research Science					PROJECT S 2307	
	COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost	
2307	Fluid Mechanics		9,395	9,954	10,599	11,274	12,147	12,383	12,630	Continuing	TBD	
(U)	A. Mission Description Fluid Mechanics research advances fundamental knowledge, tools, data, concepts, and methods for improving the efficiency, effectiveness, and reliability of aerospace vehicles. The goals are to improve theoretical models for aerodynamic prediction and design as well as to originate flow control concepts and predictive methods to expand current flight performance boundaries through enhanced understanding of key fluid flow, primarily high-speed air, phenomena. Basic research emphasis is on turbulence prediction and control, unsteady and separated flows, hypersonics, and internal fluid dynamics. The primary approach is to formulate advanced computational methods to: simulate and study complex flows; predict real gas effects in high-speed flight; and control and predict turbulence in flight vehicles and propulsion systems. Primary areas of research investigated by this project are unsteady aerodynamics, hypersonic aerodynamics, turbulence and flow control, and rotating flows.											
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$2,349	sands) Performed unsteady aerodyna designs and enable revolution flight performance of unmanr drag. Continued to develop f	umics researd ary future waned air vehic luid/structur	ch to provide veapon syste les. Continu al interaction	e fundamenta ms. Investigued to devise n design tool	al knowledge gated unstead design tools to predict	e of high-spe ly, complex, s for flow co vehicle failu	eed air flows , three-diment ontrol to min re modes in	to optimize sional flows imize flow s rapid maneu	current Air s to refine the eparation an ivers.	Force air vehicle e control and d air vehicle	
(U)	\$2,818	Conducted hypersonic aerody trans-atmospheric vehicles an magneto-hydrodynamic techr	namics rese d their fligh	arch to invest t control sys eloped high-	stigate comp tems. Adva	lex flowfield nced concep	d phenoment ts for hypers des to quant	a for enablin sonic flow co ify thermal	g the design ontrol, includ	of future Ai ling plasma a	r Force and	
(U)	 \$2,350 \$2,350 Sought fundamental knowledge of turbulence and flow control to enhance the performance, controllability, and stability in air vehicles. Evaluated novel micro-electro-mechanical systems (MEMS), actuators, and investigate actuation coupling mechanisms in turbulent flows to enable agile flight vehicles with significantly reduced power requirements. Evaluated the use of MEMS devices for flow control on swept wing air vehicles with a goal of substantial drag reduction. 											
(U)	\$1,878	Studied rotating flows to evaluate internal flow characteristics for enhancing the performance and reliability/maintainability of airbreathing propulsion systems. Evaluated promising MEMS devices for turbine engine control and Large Eddy Simulation methodology for affordable high fidelity predictions of gas turbine engine flow fields and heat transfer effects.							airbreathing for affordable			
P	پوروپور roject 2307	10181		Page	27 of 47 Pag	ges			Ex	(hibit R-2A	(PE 0601102F)	

	RDT&E	DATE February 2002									
BUD 01	GET ACTIVITY - Basic Research	F	e NUMBER AND TITLE 0601102F Defense Research Science	PROJECT S 2307							
(U)	A. Mission Descripti	on Continued									
(U)	FY 2002 (\$ in Thousa	nds)									
(U)	 \$2,490 Perform unsteady aerodynamics research to provide fundamental knowledge of high-speed air flows to optimize future Air Force air vehicle designs and enable revolutionary future weapon systems. Investigate unsteady, complex, three-dimensional flows to refine the control and flight performance of unmanned air vehicles. Complete the development of design tools for flow control to minimize flow separation and air vehicle drag. Complete the development of fluid/structural interaction design tools to predict vehicle failure modes in rapid maneuvers. 										
(U)	\$2,987	 \$2,987 Conduct hypersonic aerodynamics research to investigate complex flowfield phenomena for enabling the design of future Air Force trans-atmospheric vehicles and their flight control systems. Research advanced concepts for hypersonic flow control such as plasma or magneto-hydrodynamic techniques. Develop high-speed flow prediction codes to quantify thermal stresses. Investigate high temperature mitigation techniques for hypersonic flight vahiales. 									
(U)	\$2,487	Seek fundamental knowledge of turbulence in coordinate concepts to enhance the performance, controllability, and process. Evaluate promising flow control actuation conce agile flight vehicles with significantly reduced power red	ed experimental and computational simulation efforts I stability in air vehicles. Develop new predictive to epts and investigate flow control coupling mechanismuirements.	s. Investigate flow control ols for the air vehicle design ns in turbulent flows to enable							
(U)	\$1,990	Study complex rotating flow phenomena as they relate to enhancing the performance and reliability/maintainabilit Simulation methodology for affordable high fidelity pre- understanding of high cycle fatigue aerodynamic forcing	turbomachinery and jet engine applications. Evaluate of airbreathing propulsion systems. Continue development dictions of gas turbine engine flow fields and heat trans. Evaluate possible flow control applications in turb	ate unsteady flow phenomena for clopment of Large Eddy nsfer effects. Develop pine engines.							
(U)	\$9,954	Total		C							
(U)	FY 2003 (\$ in Thousa	<u>nds)</u>									
(U)	\$2,649	Perform unsteady aerodynamics research to provide fund designs and enable revolutionary future weapon systems flight performance of unmanned air vehicles. Investigate flow situations occurring in complex air vehicle and wea	amental knowledge of high-speed air flows to optim Investigate unsteady, complex, three-dimensional rapid maneuver unmanned air vehicle aerodynamic pon systems.	nize current Air Force air vehicle flows to refine the control and s. Investigate highly separated							
(U)	\$3,181	Investigate complex phenomena in hypersonic flows to e systems. Complete development of hypersonic flow com high-speed flow prediction codes to quantify thermal stre	nable the design of future Air Force trans-atmosphe trol concepts, including plasma and magneto-hydroc esses and design mitigation techniques for hypersoni	ric vehicles and flight control lynamic techniques. Develop c flight vehicles.							
(U)	\$2,649	Explore fundamental knowledge of turbulence in coordin	nated experimental and computational simulation eff	orts. Investigate new areas and							
F	Project 2307	Page 28	of 47 Pages	Exhibit R-2A (PE 0601102F)							

Γ	RDT&E	DATE February 2002							
BUD0 01 -	GET ACTIVITY - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT						
(U)	A. Mission Description	Continued							
(U)	FY 2003 (\$ in Thousand n r A in	ls) Continued nethods of flow control on aircraft wings and jet engines to enhance the performance, controllability, and st educed order models for turbulent flow control applications and affordable engineering predictive models for assess quality of promising flow control actuation concepts on realistic geometries. Continue investigating in turbulent flows to enable agile flight vehicles.	ability in air vehicles. Develop or the air vehicle design process. flow control coupling mechanisms						
(U)	 \$2,120 \$2,120 \$2,120 \$2,120 Study complex rotating flow phenomena as they relate to turbomachinery and jet engine applications. Evaluate unsteady flow phenomena and develop understanding of forcing modes in turbomachinery to predict and avoid high cycle and thermal failures in jet engines. Investigate application of Large Eddy Simulation techniques to explore complex gas turbine engine flow fields and heat transfer effects. Evaluate flow control measurement and actuation devices for use in harsh environments such as turbine engines. 								
(U)	\$10,599 T	otal							
(U)	<u>B. Project Change Sun</u> Not Applicable.	nmary							
(U) (U) (U) (U) (U) (U)	C. Other Program Fun Related Activities: PE 0602102F, Materials PE 0602203F, Aerospac PE 0602201F, Aerospac PE 0603211F, Aerospac	ding Summary (\$ in Thousands) e Propulsion. e Flight Dynamics. e Structures.							
(U)	D. Acquisition Strategy Not Applicable.								
(U) (U)	E. Schedule Profile Not Applicable.								
F	Project 2307	Page 29 of 47 Pages	Exhibit R-2A (PE 0601102F)						

	RDT&I	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	iry 2002
вира 01 -	GET ACTIVITY • Basic Research	ı			PE NUMBER AND TITLE 0601102F Defense Research Science					PROJECT S 2308	
	COST (\$ in Thousands) FY 2001 FY Actual Es				FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2308	Propulsion		20,937	23,104	21,190	21,635	22,102	22,505	22,914	Continuing	TBD
(U)	A. Mission Description Propulsion research seeks fundamental knowledge to enable and enhance efficient utilization of energy in airbreathing engines, chemical and non-chemical rockets, and combined cycle propulsion systems for access to space. Basic research thrusts include airbreathing propulsion, space power and propulsion, high altitude signature characterization and contamination, propulsion diagnostics, and thermal management of space-based power and propulsion systems. Two key basic research areas include reacting flows and non-chemical energetics. Study of chemically reacting flows involves the complex coupling between energy release through chemical reaction and the flow processes that transport chemical reactants, products, and energy. Study of non-chemical energetic systems include plasma and beamed energy propulsion for orbit raising space missions and efficient ultra-high energy techniques for space-based energy utilization. Primary areas of research investigated by this project are space power, propulsion, combustion, and diagnostics.										
(U) (U)	FY 2001 (\$ in Thousands) \$7,048 Performed space power and propulsion research to investigate novel propulsion mechanisms to enable superior satellite propulsion performance. Increased thrust and control of micro-satellite and nano-satellite propulsion systems to enable high-precision clusters of cooperating autonomous micro-satellites. Examined self-consuming satellites and mechanical-electric energy conversion to increase payload and thrust capabilities. Continued to develop new concepts, such as pulsed detonation, hybrid rockets, and combined cycle engines, to enable very high temperature and pressure (supercritical) combustion for optimal rocket propulsion. Studied experimental and numerical characteristics of high altitude ultraviolet and infrared signatures and satellite contamination to develop techniques to protect space assets.										
(U)	\$6,577	Studied combustion to evalua capabilities. Enhanced comp primary and secondary atomiz	te airbreathi uter models zation and m	ng propulsio to increase e tixing of fue	on systems for efficiency by ls to optimiz	or hypersonic predicting u e fuel injecti	c, supersonic insteady beh ion to increa	c, and subson avior such a se thrust out	nic flight to s combustio put.	enhance air y n instability.	warfare Examined
(U)	\$4,384	Investigated advanced diagno Obtained essential data throug chemical propulsion systems	stics system gh multiplex to increase t	s for data re ed diode-las heir thrust a	duction and i er spectrosco nd efficiency	interpretation opy that enal	n to create c bled simulta	oncepts for 1 neous detect	iovel propul	sion system erature and p	applications. ressure within
(U)	\$2,928	Continued coal-derived jet fue fuel system fouling, combusti coal-derived fuel for large-sca	els research on character ale combusti	to investigat ristics of can on, fuel syst	e refinery pr didate fuels, em fouling,	ocessing tec and fuel-ma and ignition	hniques for aterial intera experiments	coal process ctions. Prod	ing with pet uced small o	roleum, addi quantities (50	tives to suppress) gallons) of
Р	roject 2308			Page	30 of 47 Pag	ges			Ex	hibit R-2A	(PE 0601102F)

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002							
вира 01 -	BET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT							
(U)	A. Mission Descripti	on Continued								
(U) (U)	<u>FY 2001 (\$ in Thousa</u> \$20,937	nds) Continued Total								
(U) (U)	FY 2002 (\$ in Thousa \$7,263	nds) Perform space power and propulsion research to investigate novel propulsion mechanisms to enable superior Enable clusters of cooperating autonomous micro-satellites by improving thrust and control of micro- and na Research mechanical-electric energy conversion and self-consuming satellites to increase payload and thrust for optimal rocket propulsion using hybrid rockets and/or combined cycle engines. Perform research on digit detonation rocket engines. Exploit experimental university satellites to measure thrust and cross-contaminati Develop novel space diagnostic techniques and 100 gram class sensors for accurate measurements on micro-	satellite propulsion performance. no-satellite propulsion systems. Explore supercritical combustion tal propulsion and pulsed on in micro-satellite constellations. and nano-satellites.							
(U) (U)	 \$6,915 \$6,915 Study combustion to evaluate airbreathing propulsion systems for hypersonic, supersonic, and subsonic flight to enhance air warfare capabilities. Increase combustion efficiency and reduce fuel consumption through enhanced computer models that can predict unsteady behavior such as combustion instability. Advance the state of turbulent combustion simulation methods by incorporating refined models for chemistry and fuel droplets. Investigate enhancements to ignition and flame stabilization by weakly ionized flows. 									
(U)	\$1,980	Apply picosecond spectroscopic techniques to characterize turbulent combustion statistical behavior and sup Research methods for improving aerodynamics for next generation aerospace vehicles for long range strike. scientific basis for how plasmas are used to improve aerodynamic characteristics and propulsive efficiencies reducing drag and improving range by more than 10%. Perform demonstrations to prove plasma control effect engineer them into operational systems. Investigate plasma effects on lowering fuel consumption, improving providing on heard power generation, and alleviating sonic boom and engine poise.	ercritical fuel properties. Expand research to develop sound enabling hypersonic vehicles by ects and to determine how to g propulsion system performance,							
(U)	 \$2,476 \$2,476 providing on-board power generation, and alleviating sonic boom and engine noise. Continue researching coal-derived jet fuels to investigate refinery processing techniques for coal processing with petroleum, additives to suppress fuel system fouling, combustion characteristics of candidate fuels, and fuel-material interactions. Produce small quantities (50 gallons) of coal-derived fuel for large-scale combustion, fuel system fouling, and ignition experiments. Investigate potential for coal-derived for large-scale combustion fuel system fouling, and ignition experiments. 									
(U)	\$23,104	Total								
Р	roject 2308	Page 31 of 47 Pages	Exhibit R-2A (PE 0601102F)							
		31								

	RDT&E	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)									
BUD 01	GET ACTIVITY - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT 2308								
(U)	A. Mission Description	on Continued									
(U) (U)	 (U) <u>FY 2003 (\$ in Thousands</u>) (U) \$7,484 Explore space power and propulsion research to investigate novel propulsion mechanisms to enable superior satellite propulsion performance. Study means to improve thrust and control of propulsion systems to develop high-precision constellations of cooperating micro-satellites. Expand understanding of mechanical-electric energy conversion to increase payload and thrust. Study feasibility of excess silicon as a space propellant in developing concepts for self-consuming satellites. Continue researching new engine concepts such as pulsed detonation engines, hybrid rockets, and combined cycle engines. Create advanced supercritical combustion models and leverage computational capability to enhance the design of new engines. Persearch plasma turbulence and its effect on the transport coefficients to develop a new class of more 										
(U)	 enhance the design of new engines. Research plasma turbulence and its effect on the transport coefficients to develop a new class of more versatile plasma thrusters. \$7,100 \$100 <l< td=""></l<>										
(U)	\$4,606	Investigate advanced diagnostics systems for data reduction and interpretation to create concepts for novel p Study laser-induced fluorescence and absorption spectroscopic measurements in relation to infrared and ultra-	ropulsion system applications. aviolet excitation wavelength								
(U)	\$2,000	Study methods for enabling and improving aerodynamics for next generation aerospace vehicles for long rar studies to develop sound scientific basis for how plasmas are used to improve aerodynamic characteristics at hypersonic vehicles by reducing drag and improving range by more than 10%. Demonstrate plasma control engineer them into operational systems. Investigate plasma effects on lowering fuel consumption, improving providing on-board power generation, and alleviating sonic boom and engine noise.	ge strike. Further expand research ad propulsive efficiencies enabling effects and evaluate means to g propulsion system performance,								
(U)	\$21,190	Total									
(U)	B. Project Change Se Not Applicable.	<u>ımmary</u>									
F	Project 2308	Page 32 of 47 Pages	Exhibit R-2A (PE 0601102F)								

RDT&E BUDGET ITEM JUSTIFIC	DATE February 2002						
BUDGET ACTIVITY 01 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT S 2308					
 (U) <u>C. Other Program Funding Summary (\$ in Thousands)</u> (U) Related Activities: (U) PE 0602102F, Materials. (U) PE 0602203F, Aerospace Propulsion. (U) PE 0602601F, Space Technology. (U) PE 0603211F, Aerospace Structures. (U) PE 0602269F, Hypersonic Technology Program. 							
(U) D. Acquisition Strategy Not Applicable.							
 (U) <u>E. Schedule Profile</u> (U) Not Applicable. 							
Project 2308	Page 33 of 47 Pages	Exhibit R-2A (PE 0601102F)					
33 UNCLASSIFIED							

Γ	RDT&	E BUDGET ITEM JU	STIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002	
вирс 01 -	UDGET ACTIVITY 1 - Basic Research					PE NUMBER AND TITLE 0601102F Defense Research Science					PROJECT S 2311	
	COST (\$ in Thousands) FY 2001 FY 2002 Actual Estimate					FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost	
2311	Space Sciences		14,408	16,690	15,531	16,066	16,605	16,938	17,279	Continuing	TBD	
(U)	A. Mission Description Space Sciences research provides fundamental understanding of the space environment for optimum design of Air Force systems operating in near-Earth orbit, geosynchronous orbit, and deep space. The goal is to enable greater, more cost-affordable, protection of space assets from space debris, solar wind, solar flares, cosmic rays, and geomagnetic storms. Basic research focuses on specifying the flow of mass, momentum, and energy through space to develop a global model that connects solar activity with the deposition of energy at the Earth. In order to enhance the effectiveness of Air Force global dominance through space operations, methods are developed to forecast the turbulent plasma phenomena that mediate the flow of energy through space. The primary areas of research investigated by this project are solar physics and astrophysical observation techniques, solar wind transport and magnetospheric physics, ionospheric physics and scintillation, and energization processes in the Earth's radiation belts.											
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$5,762	continued support to Sacrame better prediction of large-scal defensive operational techniq physical basis for solar distur	ento Peak So e disruption ues. Discov bance mode	blar Observa s in the spac ered the phy ls. Continue	tory to analy e environme vsics of solar ed investigati	vze solar phe nt and to ad plasma arca ing sunspots	nomena to c vance develo des, solar fla , solar oscilla tions	haracterize a opment of pr ares, and con ation modes	and model so otective space onal mass e and solar m	blar phenome cecraft struct jections to es nagnetic field	ena for much cures and stablish the ls to enable	
(U)	\$4,322	forecasting of solar eruptions and predict risk to critical Air Force space operations. Studied solar wind transport to evaluate the magnetic transport of solar eruptions to formulate accurate maps of environmental vulnerability and to identify orbits that ensure continued, reliable performance of Air Force satellites. Integrated solar magnetic field and coronal data to discover the science underpinning solar ejection paths and devised accurate modeling techniques. Evaluated effects of the solar wind, the										
(U)	\$4,324	Studied the transient and long-term effects of the Earth's magnetospheric and radiation belt energization processes to predict performance degradation levels in Air Force space systems. Examined charged particle dynamics and magnetohydrodynamic fluid flow for formulation of an accurate geomagnetic substorm onset model to calculate radiation effect longevity in the Earth's satellite environment. Related fundamentals of turbulence and ionospheric scintillation to enhance design and operation of surveillance, geolocation, and communication satellites.										
(U)	\$14,408	Total										
Р	roject 2311			Page	34 of 47 Pag	ges			Ex	hibit R-2A ((PE 0601102F)	

	RDT&E	February 2002								
вирс 01 -	GET ACTIVITY • Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT							
(U)	A. Mission Descripti	on Continued								
(U) (U)	<u>FY 2002 (\$ in Thousa</u> \$3,751	nds) Analyze, characterize, and model solar phenomena for much better prediction of large-scale solar disruptions advance development of protective spacecraft structures and defensive operational techniques. Obtain high- plasma arcades, solar flares, and coronal mass ejections to establish the physical basis for solar disturbance n sunspots, solar oscillation modes, and solar magnetic field spin states to enable forecasting of solar eruptions critical Air Force space operations. Develop solar vector magnetographs using adaptive optics.	s in the space environment, and to resolution observations of solar nodels. Continue investigating and predict environmental risks to							
(U)	\$3,734	Study solar wind effects on the Earth's magnetospheric and radiation belt energization processes and morphoperformance degradation models. Develop models that provide realistic coupling of the magnetosphere - ior magnetohydrodynamic (MHD) models to develop a theoretical understanding of magnetic reconnection and magnetosphere.	logy. Enhance space systems osphere system. Conceive self-organized criticality in the							
(U)	\$4,482	\$4,482 Study ionospheric scintillation and turbulence to enhance global surveillance, geolocation, and communication. Observe atmospheric gravity wave interactions from high-latitude and tropical observation sites using light detection and ranging (LIDAR) techniques. Conduct airglow and auroral emission observations and characterize the chemical and physical dynamics of the mesosphere, thermosphere, and ionosphere to davalon comprehensive seasonal and elimitic mans of high altitude phenomena.								
(U)	\$2,990	Characterize the populations of space debris particles derived from comets and asteroids to predict threats to test bed for advanced deep space surveillance techniques through new astronomical instrumentation and observations of space backgrounds and optical signatures of orbital targets over energy deposited in near-Earth space by cosmic rays and energetic particles from deep space to identify risks	Air Force spacecraft. Provide a ervational methods. Expand laser the tropics. Research the variable s to Air Force systems.							
(U)	\$743	Research space weather phenomena through the investigation of several solar variables observed from thous evolution of our sun. Research supported through the Center for Solar Geophysical Interactions at the Mt. W	ands of sun-like stars. Model the							
(U)	\$990	Support basic research and educational outreach projects at the California Science Center to assure the Air F and engineering talent in future years. Efforts include research to increase the fundamental understanding of phenomena, and expand into biological sensory systems.	orce access to superior scientific atmospheric conditions, weather							
(U)	\$16,690	Total								
Р	Project 2311	Page 35 of 47 Pages	Exhibit R-2A (PE 0601102F)							

	RDT&	DATE February 2002							
BUD	GET ACTIVITY		PE NUMBER AND TITLE	PROJECT					
<u>01</u> ·	 Basic Research 		0601102F Defense Research Science	es 2311					
(U)	A. Mission Descript	on Continued							
(U) (U)	 <u>FY 2003 (\$ in Thousands</u>) 3,856 Analyze solar phenomena to characterize and model solar phenomena for enhanced prediction of large-scale disruptions in the space environment, and to advance development of protective spacecraft structures and defensive operational techniques. Explore technology requirements to enable development of a new ground-based Advanced Technology Solar Telescope. Advance adaptive optics techniques in solar observations. Investigate scientific analysis of space-based data. Continue investigating solar dynamo, solar oscillation modes, solar flares, coronal mass ejections, and solar magnetic field helicity to enable forecasting of solar eruptions and predict environmental risks to critical Air Force space operations 								
(U)	\$3,856 Develop mitigation techniques for ionospheric scintillation and plasma turbulence to enhance global surveillance, geolocation, and communication. Develop data assimilation techniques to modernize ionospheric and space weather forecasting. Continue to observe atmospheric gravity wave interactions from high and low geomagnetic latitudes, as well as tropical observation sites, using light detection and ranging (LIDAR) techniques in order to develop seasonal and climatic models of ionospheric phenomena.								
(U)	\$4,628 Study ionospheric scintillation and turbulence to enhance global surveillance, geolocation, and communication. Develop data assimilation techniques to modernize ionospheric and space weather forecasting. Continue to observe atmospheric gravity wave interactions from high-latitude and tropical observation sites using LIDAR techniques in order to develop seasonal and climatic models of ionospheric phenomena								
(U)	\$3,191	Predict threats to Air Force space assets by cataloging a from comets and asteroids. Develop advanced astronom for observations of Near Earth Objects and ballistic and space by energetic particles from deep space and by co	and tracking the populations of Near Earth Objects and mical instrumentation and observational methods. Ex- d orbital targets over the tropics. Investigate the varial smic rays to quantify risks to Air Force systems.	d space debris particles derived plore laser guide-star development ble energy deposited in near-Earth					
(U)	\$15,531	Total							
(U)	B. Project Change S Not Applicable.	ummary							
(U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602601F, Space Technology. PE 0602702F, Command, Control, and Communications. PE 0603410F, Space System Environmental Interactions Technology.								
F	Project 2311	Page 3	66 of 47 Pages	Exhibit R-2A (PE 0601102F)					
			26						

	RDT&E BUDGET ITE	DATE February 2002	
BUD			PROJECT
01 ·		U601102F Detense Research Science	es 2311
(U)	<u>D. Acquisition Strategy</u> Not Applicable.		
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.		
F	roject 2311	Page 37 of 47 Pages	Exhibit R-2A (PE 0601102F)
		37 UNCLASSIFIED	

	RDT&	E BUDGET ITEM JU		SHEET (R-2A Exhibit)					DATE February 2002		
BUD0 01 ·	GET ACTIVITY • Basic Researc	h			PE NUMBER AND TITLE 0601102F Defense Research Science:				ences	PROJECT 2312	
	COST (\$ in Thousands) FY 2001 FY 2002 Actual Estimate					FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2312	Biological Science	s	13,114	13,844	14,383	14,730	15,025	15,324	15,629	Continuing	TBD
(U)	U) A. Mission Description Biological Science research aims to provide the fundamental knowledge necessary to enable Air Force technologies and understanding in chemical and physical agent toxicity, biomimicry for electromagnetic sensors, biomolecular materials, biochromatics and luminescence, as well as neuroscience and chronobiology. The goal is to exploit biological properties so as 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 in order to ensure the hazard-free development and use of future aerospace materials and directed energy systems. Research in biomimetic sensors strives to mimic the biological detection systems of organisms at the molecular level in development of novel man-made sensors. Basic research in biocatalysis characterizes cellular enzymes that will catalyze the synthesis of chemical feedstocks used in the safe production of space and aerospace materials. Research in neuroscience and chronobiology provides new strategies to prevent impaired operational performance due to jet lag and shift-work, night operations, and the loss of life and/or aircraft due to stress, inattention, or lack of vigilance. The primary areas of research investigated by this project are bioenvironmental sciences, biocatalysis, chronobiology and neural adaptation, and biomimetic sensors							d physical agent y. The goal is to orce chemicals zard-free tion systems of atalyze the new strategies to or lack of a, and biomimetic			
(U) (U) (U)	 FY 2001 (\$ in Thousands) \$6,428 Studied bioenvironmental sciences to investigate and predict biological effects of novel aerospace chemicals and directed energy systems to assure the safety, health, and high-performance of military personnel during and after mission-directed activities. Evaluated underlying biochemical alterations related to the adverse effects of JP-8 jet fuel and began to identify specific protein targets responsible for triggering the toxic responses. Explored in vitro biodynamic alterations that together with biokinetic parameters aid in predicting toxicity and integrate into the computational design of new, safer, aerospace materials. Examined the effects of novel forms of directed energy (microwaves and lasers) on gene expression and identified specific sub-cellular targets of directed energy. \$3,283 Researched biocatalysis to discover and characterize enzymes from living cells used as biocatalysts to reduce cost, increase efficiency, and assure safety for synthesizing chemical feedstocks for manufacturing aerospace materials. Sub-cloned various bacterial enzymes to enhance the level of gene expression so the enzymes could be produced in sufficient yields for additional research and biotechnology development. Identified and isolated bacteria strains capable of performing efficient biochemical reaction mechanisms to reduce cost and increase efficiency of aerospace materials synthesis. 										
F	Project 2312			Page	38 of 47 Pag	ges			E>	chibit R-2A	(PE 0601102F)
	RDT&E	DATE February 2002									
---------------------	---	--	---	--	--	--	--	--	--	--	
вира 01 -	GET ACTIVITY • Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT 2312								
(U)	A. Mission Descripti	on Continued									
(U)	FY 2001 (\$ in Thousa	nds) Continued									
(U)	 environment, and individual performance capabilities to improve skilled human performance. Interpreted the mechanism by which serotonin regulates the circadian clock, determined if modafinil prevents adverse effects on performance without disrupting sleep, and investigated the combination of countermeasures such as optimally-timed rest periods and wake promoting compounds. \$1,569 Investigated biomimetic sensors to develop understanding of visual, auditory, and vestibular systems, and identified methods to enhance these systems. Analyzed, predicted, and modeled biological characteristics, behaviors, and functions for development of novel processes and mechanisms for physical and chemical system requirements. Isolated and began to model alternate mechanisms of near ambient infrared sensing systems in snakes and beetles to enable room-temperature, compact infrared sensors. Investigated and adapted chromophores and photoluminescent characteristics in microbial and protein-based biological systems for insights to military sensor applications. 										
(U)	\$13,114	Total									
(U)	FY 2002 (\$ in Thousa	<u>nds)</u>									
(U)	\$6,783	Study bioenvironmental sciences to investigate the biological effects of exposure to military aerospace chemused by the military to assure the safety, health, and high performance of personnel before, during, and after Explore the molecular and cellular effects of JP-8 jet fuel on the lung, brain, skin, and immune system and comolecular pathways involved in eliciting and blocking toxic responses. Continue to develop reliable in vitror responses and learn to use them to rapidly acquire and predict toxic profiles at a sub-cellular level. Continue gene-induced effects of directed energy (microwaves and lasers) on cellular targets and determine the approximes effects are significant.	icals and directed energy systems mission-directed activities. ontinue to identify specific simulators of in vivo toxic to identify and quantify subtle, kimate exposure levels at which								
(U)	\$3,462	Research biocatalysis to discover and characterize enzymes from living cells for use as biocatalysts to reduce assure safety in chemical feedstocks synthesis for aerospace materials. Discover, isolate, clone, and sequence the military. Biochemically characterize the enzymes and investigate their mechanisms of reaction, kinetics	e cost, increase efficiency, and se genes of novel enzymes of use to s, substrate range, and specificity.								
(U)	the military. Biochemically characterize the enzymes and investigate their mechanisms of reaction, kinetics, substrate range, and specificity. \$1,937 Perform chronobiology and neural adaptation research to examine the biological mechanisms responsible for crew fatigue, adaptation to the environment, and individual performance capabilities to improve skilled human performance. Continue to analyze the mechanism by which serotonin regulates the circadian clock. Continue researching the effect of modafinil on preventing adverse performance effects without disrupting sleep. Optimize the combination of fatigue countermeasures such as optimally-timed rest periods and alertness promoting compounds										
(U)	\$1,662	Conduct biomimetic research to enable the development of novel sensors, engineering processes, and mecha	nisms. Investigate fundamental								
Р	Project 2312	Page 39 of 47 Pages	Exhibit R-2A (PE 0601102F)								

	RDT&E	DATE February 2002							
вирс 01 -	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT S 2312						
(U)	A. Mission Descripti	on Continued							
(U)	FY 2002 (\$ in Thousands) Continued biological properties and processes of infrared sensitive biosystems at the cellular, sub-cellular, and molecular levels to enable the development of novel infrared materials and devices with enhanced structural and functional capabilities. Identify, isolate, and model alternate mechanisms of near ambient infrared sensing in biosystems to enable and/or enhance compact, room-temperature infrared sensors. Probe the functionality of alternative sensors for time-response characteristics. Investigate biochromophores and biophotoluminescent characteristics in microbial and protein-based biosystems for application to military sensors.								
(U)	\$13,844	Total							
(U)	FY 2003 (\$ in Thousa	unds)							
(0)	\$7,047 Study bioenvironmental sciences to investigate the biological effects produced by exposure to aerospace chemicals and directed energy systems used by the military to assure the safety, health, and high performance of the warfighter before, during, and after mission-directed activities. Continue to identify organ-specific molecular pathways altered by JP-8 jet fuel exposures and evaluate 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. Explore mechanisms and develop 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 aerospace chemicals and new forms of directed energies. Investigate the biological effects of chronic low level exposures to directed energy by profiling and modeling intracellular molecular responses and identifying potentially harmful externelly be available because the safety.								
(U)	\$3,596	Research biocatalysis to discover and characterize enzymes from living cells that can be used as biocatalysts and assure safety in the process of synthesizing chemical feedstocks used in the manufacture of aerospace ma fundamental process of enzyme discovery and characterization. Genetically modify the natural biocatalytic p various synthetic manufacturing requirements by extending substrate ranges and specificities or altering reac metabolic engineering techniques for maintaining or enhancing reaction rates during large scale production.	to reduce cost, increase efficiency, aterials. Continue the essential and potential of enzymes to meet tion rates. Explore alternative						
(U)	\$2,014	Perform chronobiology and neural adaptation research to examine the biological mechanisms responsible for environment, and individual performance capabilities to improve skilled human performance. Explore the m influences the circadian clock. Conduct studies using optimally-timed rest periods and wake promoting com Develop a mathematical model to recommend the best use of light exposure, caffeine, modafinil, and brief na and sustained sleep deprivation.	crew fatigue, adaptation to the echanism by which serotonin pounds to extend waking activity. aps to counter the effects of jet lag						
(U)	\$1,726	Continue to conduct biomimetic research to enable the development of novel sensors, engineering processes,	and mechanisms. Model the						
Р	roject 2312	Page 40 of 47 Pages	Exhibit R-2A (PE 0601102F)						

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								
вир 01	GET ACTIVITY - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT S 2312						
(U) (U)	A. Mission Description Continued FY 2003 (\$ in Thousands) Continued fundamental principles, processes further development of infrared m construct alternative biomimetic, time-response characteristics. Ac applications to military sensor sy	es, and designs of infrared sensitive biosystems at the sub-cellular, molecular materials, devices, and systems with enhanced structural and functional capat , near ambient infrared sensing devices. Probe and manipulate the functional dapt biochromophores and biophotoluminescent characteristics in microbial a ystems.	and genomic levels to enable the bilities. Identify, model, and ity of alternative sensors for and protein-based biosystems for						
(U) (U)	\$14,383 Total<u>B. Project Change Summary</u> Not Applicable.								
(U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousand Related Activities: PE 0602202F, Human Effectiveness Applied Research. PE 0602204F, Aerospace Sensors. PE 0602602F, Conventional Munitions. PE 0602702F, Command, Control, and Communication.	<u>ds)</u>							
(U)	D. Acquisition Strategy Not Applicable.								
(U) (U)	E. Schedule Profile Not Applicable.								
F	Project 2312	Page 41 of 47 Pages	Exhibit R-2A (PE 0601102F)						

	RDT&	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
вира 01 -	BET ACTIVITY Basic Researc	h			PE NUMBE	R AND TITLE 2F Defer	nse Rese	arch Scie	ences		PROJECT 2313
	COST (\$ in Thousands) FY 2001 FY 2002 Actual Estimate				FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2313	Human Performar	nce	13,747	12,885	13,044	13,113	12,471	12,706	12,965	Continuing	TBD
(U)	A. Mission Description Human Performance research aims to provide the fundamental knowledge necessary to examine all aspects of human information processing critical to Air Force operations. The goal is to develop useful quantitative models of the way people: perceive, navigate, 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, vestibular, and kinesthetic systems and their optimal integration. Basic research topics focus investigations on the scientific foundation for several developing Air Force technologies including the design of interactive displays, simulators, intelligent control systems, sensors and fused-image displays, and adaptive systems for operator and team training. The primary areas of research investigated by this project are sensory and perceptual systems, cognition, and team performance.										
(U)	FY 2001 (\$ in Thou	sands)									
(U)	\$3,449	Performed sensory and percep Force weapon systems. Refin sound for optimal cockpit per and for effective design of inf sensing devices.	ptual system ned theories formance. A formative dis	research to of visual sea Analyzed the splays. Gair	investigate s arch and scer perceptual a aed understar	ensory and p the analysis, c and cognitiv anding of hur	perceptual sy control of att e requirement man multise	vstems to enh ention, percents for accura nsory integra	nance human eption of ori ate simulation ation to enab	n-machine in entation, and on of virtual ole the design	teraction in Air l localization of environments n of automated
(U)	\$4,853	Conducted cognition research multiple crew member interac compensate for human limitat operation.	to measure ctions. Enha tions. Devel	and analyze inced human loped and tes	cognitive di performanc sted training	mensions of e via intellig protocols to	f human perf gent systems maximize t	formance in o that aid hum eam effective	complex cor nan behavior eness under	nmand and c ral and cogni stress and su	ontrol tasks with tive functions or stained
(U) (U)	\$4,468 \$977	Studied cognitive workload to formulate behavioral and physiological measures of cognitive workload, alertness, and vulnerability to sleep loss to enable cognitive performance modeling and prediction. Invented innovative approaches to understanding individual skill differences and created new training and selection systems relevant to modern, technology-dependent environments. Studied behavioral and physiological measures to avert human error in conditions of information overload and fatigue. Supported basic research and educational outreach projects at the Chabot Observatory and Science Center to assure the Air Force access to superior scientific and engineering talent in future years. Efforts included research to increase the fundamental understanding of the upper atmosphere.									
Р	roject 2313			Page	42 of 47 Pag	ges			Ex	hibit R-2A	(PE 0601102F)

	RDT&E	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)							
BUDO	GET ACTIVITY		PE NUMBER AND TITLE	PROJECT					
01 -	Basic Research		0601102F Defense Research Science	es 2313					
(U)	A. Mission Descripti	on Continued							
(U)	FY 2001 (\$ in Thousa	nds) Continued							
(U)	\$13,747	Total							
(U)	FY 2002 (\$ in Thousa	nds)							
(U)	\$3,480 Perform sensory and perceptual system research to investigate sensory and perceptual systems to enhance human-machine interaction in Air Force weapon systems. Develop theories for models of human-machine interaction in Air Force weapon systems. Critically test theories of visual search and scene analysis, and control of attention using measures of performance identified in several task domains. Create models for perceptual and cognitive requirements for accurate simulation and for effective design of informative displays. Develop laboratory apparatus to test theories of sensory integration for image understanding.								
(U)	\$4,895	Conduct cognition research to measure and analyze cog multiple crew-member interactions. Develop models of and evaluate theories of training for operator and team e	nitive dimensions of human performance in complex enhanced human performance aided or augmented b ffectiveness under stress and sustained operation.	command and control tasks with by intelligent systems. Discover					
(U)	\$4,510	Study cognitive workload to validate behavioral and phy several domains of operator performance. Model relation methodologies. Study behavioral and physiological met-	vsiological measures of cognitive workload, alertness onships between individual skill differences and inter asures to avert human error in conditions of informat	s, and vulnerability to sleep loss in actions with new training ion overload and fatigue.					
(U)	\$12,885	Total							
(U)	FY 2003 (\$ in Thousa	<u>nds)</u>							
(U)	\$3,522	Perform sensory and perceptual system research to inve Force weapon systems. Critically test theories of sensor processing in Air Force weapon systems. Discover imp and command and control in several task domains. Eva sensor processing. Using performance metrics, critically	stigate sensory and perceptual systems to enhance hury and perceptual systems for enhanced human-mach roved methods for evaluating design options for visu luate theories and models of perception and cognition y test theories of sensory integration for image under	man-machine interaction in Air ine interaction and sensor al displays used in scene analysis n for accurate simulation and fused estanding.					
(U)	\$4,957 Conduct cognition research to measure and analyze cognitive dimensions of human performance in complex command and control tasks with multiple crew-member interactions. Extend models of cognitive dimensions of human performance in complex command and control tasks to inform studies of automated decision making. Test models of enhanced human performance aided or augmented by intelligent systems. Determine mechanisms affecting training effectiveness for operator and team performance under stress and sustained operation.								
(U)	\$4,565	Study cognitive workload by using developed metrics to and vulnerability to sleep loss in several domains of ope	o critically test behavioral and physiological theories rator performance. Develop theories for modeled rel	of cognitive workload, alertness, lationships between individual skill					
Р	roject 2313	Page 43	3 of 47 Pages	Exhibit R-2A (PE 0601102F)					

	RDT&E BUDGET ITEM JUSTIFICATION	I SHEET (R-2A Exhibit)	DATE February 2002
BUD(01 ·	BET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT 2313
(U) (U) (U) (U) (U) (U) (U) (U)	A. Mission Description Continued FY 2003 (\$ in Thousands) Continued differences and interactions with envisioned training conditions of information overload and fatigue. \$13,044 Total B. Project Change Summary Not Applicable. C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602202F, Human Effectiveness Applied Research. PE 0602702E Command Control and Communication	g pedagogies. Determine behavioral and physiological n	neasures to avert human error in
(U) (U) (U)	 D. Acquisition Strategy Not Applicable. E. Schedule Profile Not Applicable. 		
F	roject 2313 Pag	ge 44 of 47 Pages	Exhibit R-2A (PE 0601102F)

	RDT8	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
вирс 01 -	BET ACTIVITY Basic Researd	ch			PE NUMBE	R AND TITLE 2F Defer	nse Rese	arch Sci	ences		PROJECT 4113
	COST (\$	§ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4113	External Researc	ch Programs Interface	4,241	6,584	7,399	7,511	7,650	7,467	7,618	Continuing	TBD
(U)	(J) <u>A. Mission Description</u> External research programs interface optimizes interactions between the international and domestic research community and Air Force researchers. These professional interchanges and collaborations stimulate scientific and engineering education beneficial to the Air Force, increase the awareness of Air Force basic research priorities, and attract talented scientists and engineers to address Air Force needs. Consideration is provide to enhance educational interactions with historically black colleges and universities (HBCU) and minority institutions (MI). The primary elements of this effort are international strategy, international technology liaison, and scientist and engineer research interchange.										
(U) (U)	FY 2001 (\$ in Thousands) \$1,400 Supported the Air Force Research Laboratory international strategy mission to provide centralized international expertise to assist formulation of optimal cooperation with, and leveraging of, foreign science programs to the benefit of the Air Force. Provided the primary interface with the Office of the Secretary of Defense, the Office of the Secretary of the Air Force, and Air Force Materiel Command to coordinate										
(U)	\$1,664	Supported international techn Force. Used the European Off provide on-site coordination v delegations. Sustained and fu	ology liaison fice of Aeros with internat	n missions to space Researce ional researce prce commit	identify un rch and Deve ch organizati ments to NA	ique internat elopment and ons and supj TO-affiliated	tional research the Asian (port internat d research in	ch capabiliti Office of Ae ional visits c	es making th rospace Res of high level h as the Vor	nem available earch and De Department Karman Ins	e to the Air evelopment to of Defense stitute.
(U)	\$1,177	delegations. Sustained and funded Air Force commitments to NATO-affiliated research institutes, such as the Von Karman Institute. Supported scientist and engineer education to assure the Air Force of continuing availability of superior scientific and engineering talent by supporting exceptional individuals and forging relationships between premiere scientists and the Air Force Research Laboratory. Improved awareness of Air Force research needs throughout the civilian scientific community while simultaneously identifying and recruiting the best									
(U)	\$4,241	Total									
Р	roject 4113			Page	45 of 47 Pag	ges			E>	hibit R-2A	(PE 0601102F)

	RDT&E	DATE February 2002						
виро 01 -	GET ACTIVITY • Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT S 4113					
(U)	A. Mission Description	on Continued						
(U)	FY 2002 (\$ in Thousa	<u>nds)</u>						
(U)	\$2,170	Support the Air Force Research Laboratory international strategy mission to provide centralized international optimal cooperation with, and leveraging of, foreign science programs to the benefit of the Air Force. Provid of the Secretary of Defense, the Office of the Secretary of the Air Force, and Air Force Materiel Command to participation among appropriate U.S. Department of Defense organizations.	e expertise to assist formulation of e the primary interface with Office o coordinate international					
(U)	\$2,569	Support international technology liaison missions to identify unique international research capabilities, and n Air Force. Use the European Office of Aerospace Research and Development and the Asian Office of Aerosp provide on-site coordination with international research organizations, and support international visits of high delegations. Sustain and fund Air Force commitment to NATO-affiliated research institutes, such as the Vor	akes them available to the U.S. pace Research and Development to n level Department of Defense n Karman Institute.					
(U)	\$1,845 Support scientist and engineer exchange efforts to assure the Air Force of continuing availability of superior scientific and engineering talent by supporting exceptional individuals and forging relationships between premiere scientists and the Air Force Research Laboratory. Improve awareness of Air Force research needs throughout the civilian scientific community while simultaneously identifying and recruiting the best scientific talent to participate in critical Air Force research.							
(U)	\$6,584	Total						
(U)	FY 2003 (\$ in Thousa	<u>nds)</u>						
(U)	\$2,441	Support the Air Force Research Laboratory international strategy mission to provide centralized international optimal cooperation with, and leveraging of, foreign science programs to the benefit of the Air Force. Provid Office of the Secretary of Defense, the Office of the Secretary of the Air Force, and the Air Force Materiel C international participation among appropriate U.S. Department of Defense organizations.	expertise to assist formulation of le the primary interface with the command to coordinate					
(U)	\$2,886	Support international technology liaison missions to identify unique international research capabilities, and n Force. Through the European Office of Aerospace Research and Development and the Asian Office of Aero provide on-site coordination with international research organizations and support international visits of high delegations. Sustain and fund Air Force commitment to NATO-affiliated research institutes, such as the Vor	hake them available to the U.S. Air space Research and Development level Department of Defense Karman Institute.					
(U)	 \$2,072 \$2,072							
Р	Project 4113	Page 46 of 47 Pages	Exhibit R-2A (PE 0601102F)					

	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 2002	
вира 01 -	GET ACTIVITY • Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Science	PROJECT es 4113
(U)	A. Mission Description Continued		
(U)	FY 2003 (\$ in Thousands) Continued to participate in critical Air Force research. \$7 399 Total		
(U)	B. Project Change Summary Not Applicable.		
(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0601103D, University Research Initiative. PE 0602102F, Materials. PE 0602202F, Aerospace Flight Dynamics. PE 0602202F, Human Effectiveness Applied Research. PE 0602203F, Aerospace Propulsion. PE 0602204F, Aerospace Avionics. PE 0602269F, Hypersonic Technology Program. PE 0602601F, Space Technology (formerly Phillips Lab). PE 0602602F, Conventional Munitions. PE 0602702F, Command, Control and Communication.		
(U)	D. Acquisition Strategy Not Applicable.		
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.		
P	Project 4113 Page	e 47 of 47 Pages	Exhibit R-2A (PE 0601102F)
		47	

THIS PAGE INTENTIONALLY LEFT BLANK

PE TITLE: Materials

	RDT&E BUDGET ITEM J	USTIFIC	CATION	SHEET	(R-2 E)	(hibit)		DATE	Februa	ary 2002
BUDGET 02 - A	BUDGET ACTIVITY PE NUMBER AND TITLE 02 - Applied Research 0602102F Materials									
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	91,975	97,989	75,272	77,104	78,329	79,204	82,135	Continuing	TBD
4347	Materials for Structures, Propulsion, and Subsystems	62,036	61,777	40,907	42,634	42,701	43,104	45,036	Continuing	TBD
4348	Materials for Electronics, Optics, and Survivability	9,932	14,950	12,616	12,707	13,033	13,158	13,530	Continuing	твр
4349	Materials Technology for Sustainment	20,007	19,850	18,064	18,089	18,386	18,548	18,991	Continuing	TBD
4915	Deployed Air Base Technology	0	1,412	2,345	2,236	2,515	2,582	2,647	Continuing	TBD
5015	Rocket Materials Technology	0	0	1,340	1,438	1,694	1,812	1,931	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: In FY 2002, Project 4397 efforts transferred from PE 0602102F into Project 4915, Deployed Air Base Technology. In FY 2003, space unique tasks in Projects 4347 and 4348 will be transferred to PE 0602500F, Project 5025 in conjunction with the Space Commission recommendation to consolidate all space activities. In FY 2003, non-space unique tasks (and other aerospace materials related technology) will be transferred into Project 5015, Rocket Materials Technology, from PE 0602203F, Aerospace Propulsion, Project 4847, Rocket Propulsion Technology.

(U) <u>A. Mission Description</u>

The Materials program develops advanced materials and processing technologies to reduce life cycle costs and improve performance, affordability, supportability, reliability, and survivability of current and future Air Force systems. The program has four projects which: (1) develop structural, propulsion, and sub-systems materials and processes technologies; (2) develop electronic, optical, and survivability materials and processes technologies; (3) develop sustainment materials and processes technologies; and (4) develop air base operations technologies including power generation, deployable shelters, and fire fighting. Note: In FY 2002, Congress added \$3.0 million for the Metals Affordability Initiative, \$6.0 million for advanced physical vapor silicon carbide crystal device technology, \$2.0 million

Page 1 of 20 Pages

Exhibit R-2 (PE 0602102F)

	RDT&E BUDGET ITEM JUSTIFIC	ATION SHEET (R-2 Exhib	oit)	DATE Febru	ary 2002
BUD0 02 -	GET ACTIVITY - Applied Research	PE NUMBER AND TITLE 0602102F Materials			
(U)	<u>A. Mission Description Continued</u> for durable hybrid coatings for aircraft systems, \$3.4 million for c \$1.7 million for free electron laser, and \$4.3 million for titanium r and out.	arbon foam development for aircraft and natrix composites. This explains the percent	spacecraft, \$1.0 mi ceived overall decre	illion for environmenta ease in the Materials pr	lly sound coatings, ogram in FY 2003
(U)	B. Budget Activity Justification This program is in Budget Activity 2, Applied Research, since it d revolutionary technologies.	levelops and determines the technical fea	sibility and military	y utility of evolutionary	7 and
(U)	<u>C. Program Change Summary (\$ in Thousands)</u>				
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>
(U)	Previous President's Budget	96,422	77,164	78,037	
(U)	Appropriated Value	97,315	98,564		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions		-575		
	b. Small Business Innovative Research	-2,265			
	c. Omnibus or Other Above Threshold Reprogram	-2,182			
	d. Below Threshold Reprogram				
	e. Rescissions	-893			
(U)	Adjustments to Budget Years Since FY 2002 PBR			-2,765	
(U)	Current Budget Submit/FY 2003 PBR	91,975	97,989	75,272	TBD
(U)	Significant Program Changes: In FY 2003, the decrease in this program is due to the transfer of space unique activities. Additionally, in FY 2002, this program re	space unique tasks in conjunction with th ceived Congressional Adds which explai	ne Space Commissi ns the perceived de	on recommendation to crease in FY 2003.	consolidate all
		Page 2 of 20 Pages		Exhibit R-2	2 (PE 0602102F)
		50			

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								Februa	iry 2002
BUDGET	BUDGET ACTIVITY				R AND TITLE			·		PROJECT
02 - Applied Research				060210	0602102F Materials					4347
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4347	Materials for Structures, Propulsion, and Subsystems	62,036	61,777	40,907	42,634	42,701	43,104	45,036	Continuing	TBD

Note: In FY 2003, space unique tasks in Project 4347 will be transferred to PE 0602500F, Project 5025, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) <u>A. Mission Description</u>

Develops materials and processing technology base for aircraft and missiles to improve affordability, maintainability, and performance of current and future Air Force systems. Advanced thermal protection materials are being developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet aerospace and missile requirements. A family of affordable lightweight materials are being developed, including metals, polymers, ceramics, metallic composites, and nonmetallic composites to provide upgraded capability for existing aircraft, missile, and propulsion systems to meet the future system requirements. Develop high temperature turbine engine materials that will enable engine designs to double the turbine engine thrust to weight ratio. Alternative or replacement materials are developed to maintain the performance of aging operational systems. Friction and wear resistant materials, paints, coatings, and other pervasive nonstructural material technologies are being developed for the subsystems on aircraft, spacecraft, and missile systems as well as their propulsion systems. Concurrent development of advanced processing methods to enable `adaptive' processing of aerospace materials. Note: In FY 2002, Congress added \$3.0 million for Metals Affordability Initiative, \$2.0 million for durable hybrid coatings for aircraft systems, \$3.4 million for carbon foam development for aircraft and spacecraft, \$4.3 million for titanium matrix composites, \$1.7 million for free electron laser, and \$1.0 million for environmentally sound coatings which explains the perceived decrease in FY 2003.

(U) <u>FY 2001 (\$ in Thousands)</u>

- (U) \$4,982
 Developed enabling polymeric materials technologies for diverse, high-payoff Air Force system needs including structural applications. Evaluated suitable polymers and conductive elastomers as base materials for low-observable gap sealants, thin wires, and electrostatic discharge coatings. Evaluated toughened and nanostructured polymers for thin films to enable inflatable membrane structures such as deployable mirrors for surveillance and space counterforce applications. Developed new methods for rapid fabrication of nanometer to micron three-dimensional structures and rapid composite repair.
- (U) \$10,064 Developed and transitioned nonstructural materials technology base for fluids, lubricants, aircraft topcoat, and corrosion resistant coatings and specialty treatments to improve system performance and reduce life cycle costs. Developed advanced lubricant materials for high-speed bearing and rotating components (gyroscopes) in spacecraft and fabricate optically tailorable thermal control coatings with controlled

Project 4347	Page 3 of 20 Pages	Exhibit R-2A (PE 0602102F)

	RDT&E	DATE February 2002	
BUD0 02 -	GET ACTIVITY - Applied Resear	PE NUMBER AND TITLE Ch 0602102F Materials	PROJECT 4347
(U)	A. Mission Description	on Continued	
(U)	<u>FY 2001 (\$ in Thousa</u>	nds) Continued	
(U)	\$18,282	emissivity for spacecraft thermal control. Validated feasibility of electrically conductive elastomers for use is and develop analytical techniques to predict the optical properties of specialty coatings. Developed permane and environmentally safe corrosion protection with a 30-year life for aircraft platforms. Developed affordable, advanced organic matrix composite structural materials and technologies for Air Forc lightweight structures (airframes, control surfaces, trusses, struts, engine components, substructures), space v structures, radiators, and other structures requiring thermal and/or structural management for environmental and/or mechanics models which predict component dimensions and decrease the amount of shimming, rework structures for future Air Force air platforms. Developed composite material degradation mechanisms to imp	in low-observable gap treatments ent corrosion resistant primer resins e systems applications including vehicles tanks, space vehicle bus control. Validated processing rk, and fit up for large integrated rove life prediction for aircraft
(U)	\$23.081	environmental control systems and hot, exhaust-washed structures and engine components. Validated non-ar structural, cryogenics tanks, and substructures for future Air Force space platforms and develop materials are multifunction composites enabling small, highly tailorable space platforms. Evaluated novel product forms (lightweight, tough, and affordable structural materials. Developed and transitioned affordable lightweight metallic materials, behavior and life prediction technology	utoclave processes for large d process for low-cost, (foams, nanomaterials) for y, higher temperature intermetallic
		alloys, and metals processing technology to enhance performance, lower acquisition cost, increase durability Force weapon systems. Transitioned wrought gamma titanium aluminides with a 200°F higher temperature of advanced gas turbine engine critical components. Developed specific molybdenum-based and niobium-base potential of achieving a 300°F temperature capability increase over turbine blade materials. Developed life p better predict the impact of high cycle fatigue damage on critical engine components. Developed life predict technologies to extend turbine engine rotor life, establish retirement for cause criteria, and enable repair proc Optimized and transitioned process technologies, such as permanent mold casting, laser forming, and roll for affordable and high quality metallic components. Optimized metallic materials, such as discontinuously rein aluminum, and high temperature metallic sheets to produce lightweight, high strength components for space space vehicles.	a, and improve reliability of Air capability for demonstration in d intermetallic alloys with the prediction and design methods to tion methodologies and inspection resses for critical components. Thing to enable the production of aforced aluminum, nanocrystalline systems and thermal protection for
(U)	\$5,627	Developed ceramics and ceramic matrix composites technologies for enhanced performance and supportability propulsion systems and high temperature aerospace structures. Determined the durability of ceramics under further materials development and to assess useable life. Tested integrally woven ceramic composite structure vehicle applications, develop thermal protection materials with improved durability for emerging reusable sp	ity improvements in advanced service life conditions to guide res for actively cooled space pace vehicles, and evaluate ceramic
P	Project 4347	Page 4 of 20 Pages	Exhibit R-2A (PE 0602102F)
		52	

	RDT&	DATE February 2002			
вира 02 -	GET ACTIVITY • Applied Resear	PROJECT 4347			
(U)	A. Mission Descript	on Continued			
(U)	FY 2001 (\$ in Thouse	rs and airfoils through extensive rability of reduced cost ceramic antifying the shelf life of the repair osite testing.			
(U)	\$62,036	Total			
(U) (U)	<u>FY 2002 (\$ in Thous:</u> \$8,126 \$14,086	Develop enabling polymeric materials for diverse aerospace structural applications including spacecraft mirr canopies, micromechanical devices, and advanced wiring concepts. Evaluate toughened and nanostructured in Air Force aircraft and space applications. Demonstrate and verify new methods for rapid fabrication of m for Air Force micromechanical devices. Demonstrate use of hybrid thin wires for aircraft and spacecraft app flexible, higher efficiency polymeric fibers for photovoltaic advanced solar cells. Optimize light-absorbing p incorporation into paint formulations for corrosion characterization applications. Develop affordable, advanced organic matrix composite structural materials and technologies for Air Force s lightweight structures requiring thermal and/or structural management for environmental control. Scale-up a processing and/or mechanics models which predict component dimensions improving low-observable and af structures for future Air Force air platforms. Investigate specific composite material degradation mechanism	or applications, enhanced aircraft polymers as temperature resistant icron three-dimensional structures lications. Investigate feasibility of polymeric materials for systems applications including and publish demonstrated fordability for large integrated as to improve life prediction for		
(U) P	 (U) \$10,875 Develop and transition nonstructural materials for fluids, lubricants, aircraft topcoat, and corrosion resistant coatings and specialty treat improve system performance and reduce life cycle costs. Test optically tailorable thermal control coatings with controlled heat dissipat spacecraft thermal control. Evaluate effects of the space environment on polymer and thermal control coatings. Explore electrically coel elastomers for use in low-observable gap treatments. Establish baseline analytical techniques to predict the optical properties of special coatings. Process permanent corrosion resistant primer resins and environmentally safe corrosion protection with a 30-year life for airc surfaces. Identify nanostructured multifunctional coatings to control friction and wear in extreme operating environments. Evaluate surfaces of 20 Pages 				
		53			

	RDT&E	DATE February 2002					
BUD0 02 -	GET ACTIVITY - Applied Resear	ch PE NUMBER AND TITLE 0602102F Materials	PROJECT 4347				
(U)	A. Mission Descripti						
(U)	FY 2002 (\$ in Thousa	unds) Continued					
(U) (U)	 (U) \$24,578 Develop and transition affordable lightweight metallic materials, behavior and life prediction technologies, higher temperature intermetallic alloys, and metals processing technology to enhance performance, lower acquisition cost, increase durability, and improve reliability for weapon systems. Demonstrate life prediction methodology and surface treatments needed to prevent High Cycle Fatigue damage in integrally bladed rotors. Characterize high temperature metallic alloys with the potential of achieving a 300°F temperature capability increase over current turbine blade materials. Refine damage-tolerant life prediction methodologies for high temperature resistant titanium alloy for their use in fracture-critical turbine engine applications. Develop advanced affordable process technologies to enable more affordable production of complex structural metal components for air and space vehicles. Develop processing methods for the metallic materials for lightweight, high-strength components in future space vehicles. (U) \$4,112 Develop ceramics and ceramic matrix composite technologies for enhanced performance and supportability improvements in advanced propulsion systems and high temperature aerospace structures. Evaluate ceramic composites for exhaust and hot section components under read simulated service life conditions, with a focus toward life prediction and durability assessment. Develop highly durable thermal protection 						
(U)	\$61,777	material coating repair for re applications. Initiate					
(U) (U)	<u>FY 2003 (\$ in Thous</u> \$2,761	nds) Develop enabling polymeric materials for diverse aerospace structural applications including enhanced aircr devices, advanced wiring concepts, and improved low-observable platforms. Demonstrate feasibility of nan- temperature resistent applications and evaluate applicability for gas and fluid containment components for po- subcomponent applications. Demonstrate and transition new methods for rapid fabrication of micron three-	aft canopies, micromechanical ostructured materials for ervasive Air Force aerospace dimensional structures for Air				
F	Project 4347	Porce micromechanical devices. Demonstrate and transition use of hybrid thin wires for Air Force aerospace Demonstrate light-absorbing polymeric materials for incorporation into paint formulations for corrosion char Investigate new methods for room temperature cure of resins for advanced Air Force composite applications materials for low-observable gap-sealants in Air Force aircraft applications. Page 6 of 20 Pages	e component applications. racterization applications. . Evaluate the use of conductive Exhibit R-2A (PE 0602102F)				

	NDIGL	February 2002	
BUDGE 02 - /	et activity Applied Resear	ch PE NUMBER AND TITLE 0602102F Materials	PROJECT 4347
(U)	A. Mission Descripti	on Continued	
(U) (U)	<u>FY 2003 (\$ in Thousa</u> \$8,059	<u>Inds) Continued</u> Develop affordable, advanced organic matrix composite structural materials and technologies for lightweight structures for aerospace subcomponents and other structures requiring thermal and/or control. Develop composite material degradation mechanisms to improve life prediction for airc exhaust-washed structures and engine components. Develop next generation high temperature of platforms. Continue processing and fabrication of novel product foams such as nanomaterials, na tough, and affordable structural materials.	r Air Force systems applications including r structural management for environmental raft environmental control systems and hot, rganic matrix composites for aerospace anotubes, and carbon foams for lightweight,
(U)	\$6,802	Develop and transition nonstructural materials for fluids, lubricants, aircraft topcoat and corrosio improve system performance and reduce life cycle costs. Develop electrically conductive elastor Develop advanced analytical techniques to predict the optical properties of specialty coatings. To and environmentally safe corrosion protection with a 30-year life. Establish baseline for nanostructural friction and wear in extreme environments. Develop surface treatments for friction, stiction, and	in resistant coatings, and specialty treatments to mers for use in low-observable gap treatments. 'est permanent corrosion resistant primer resins uctured multifunctional coatings to control I wear control in micro devices.
(U)	\$17,729	Develop and transition affordable lightweight metallic materials, behavior and life prediction tech alloys, and metals processing technology to enable enhanced performance, lower acquisition cost for Air Force weapon systems. Transition life prediction methodology and surface treatments ne integrally bladed rotors. Develop processing methods for second-generation alloys with the pote capability increase over current turbine blade materials. Develop computational methods for mo metallic alloys. Optimize and transition advanced affordable process technologies to enable mor metal components for Air Force aerospace vehicles.	hnology, higher temperature intermetallic t, increased durability, and improved reliability weded to prevent High Cycle Fatigue damage in ential of achieving a 300°F temperature odeling the mechanical properties of specific re affordable production of complex structural
(U)	\$3,421	Develop ceramics and ceramic matrix composites technologies for revolutionary performance an propulsion systems and high temperature aerospace structures. Test advanced ceramic composite under real and simulated service life conditions, using the data for durability assessment and life durable thermal protection materials for aerospace vehicles with aircraft-like operability through Demonstrate radar absorbing material coating repair for superalloy and/or titanium alloy substrat based on emerging fibers and advanced interface coatings.	Id supportability improvements in advanced es for exhaust and hot section components prediction development. Demonstrate highly hot acoustic and other specialized testing. tes. Evaluate more durable ceramic composites
(U)	\$2,135	Develop and transition materials processing technologies involving process models, multi-object non-invasive sensors. Investigate the feasibility of using evanescent microwave or inelastic phot near-surface region as a process sensor. Evaluate new techniques for generating large-scale dyna	ive optimization methods, and advanced ton (Raman) imaging of the surface and amic and phase behavior simulations for
Pro	oject 4347	Page 7 of 20 Pages	Exhibit R-2A (PE 0602102F)

	RDT&E BUDGET ITEM JUSTIFICATI	DATE February 2002	
BUD0 02 ·	BET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT 4347
(U) (U) (U) (U)	A. Mission Description Continued FY 2003 (\$ in Thousands) Continued nanomaterial process design. Transition an intermultiple sites over the internet web. \$40,907 Total B. Project Change Summary Not Applicable.	eractive design-manufacturing environment which allow	ws rapid design interaction between
(U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0603112F, Advanced Materials for Weapon Systems PE 0603211F, Aerospace Systems PE 0603202F, Aeropropulsion Subsystem Integration. PE 0603216F, Aeropropulsion and Power Technology PE 0602500F, Multi-disciplinary Space Technology This project has been coordinated through the Reliance process to harm	nonize efforts and eliminate duplication.	
(U) (U) (U)	 D. Acquisition Strategy Not Applicable. E. Schedule Profile Not Applicable. 		
F	roject 4347	Page 8 of 20 Pages	Exhibit R-2A (PE 0602102F)

	RDT&	E BUDGET ITEM JU	JSTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ary 2002
BUDO 02 -	BET ACTIVITY Applied Resear	rch			PE NUMBE	R AND TITLE	rials				PROJECT 4348
	COST (\$ ii	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4348	Materials for Electro	onics, Optics, and Survivability	9,932	14,950	12,616	12,707	13,033	13,158	13,530	Continuing	TBD
Note conse	In FY 2003, space un blidate all space unique	nique tasks in Project 4348 will e activities.	be transferr	ed to PE 060)2500F, Proj	ect 5025, in	conjunction	with the Sp	ace Commis	sion recomn	nendation to
(U)	J) <u>A. Mission Description</u> Develops materials technologies for surveillance and terrestrial situational awareness systems and subsystems for aircraft and missile applications. Develops materials for protection of aircrews, sensors, and aircraft from laser and high power microwave directed energy threats. Develops sensor modules, microwave devices, infrared detectors, and infrared countermeasures devices are used in target detection, weapons targeting, electronic warfare, and active aircraft protection. Electronic and optical materials are being developed to enable surveillance and terrestrial situational awareness with higher operating speeds, greater tunability, higher output power, improved thermal management (including higher operating temperatures), greater sensitivity, and extended dynamic range. Materials are being developed to counter the most prominent threat laser wavelengths and new materials are being developed to respond to emerging threat wavelengths and ultimately to reject the directed energy independent of agile threat wavelengths, without impairing mission effectiveness. Note: In FY 2002, Congress added \$6.0 million for advanced silicon										
(U)	FY 2001 (\$ in Thous	ands)									
(U) (U)	 \$4,408 Developed materials and process technologies for power control and microwave devices to provide improved performance, affordability, and operational capability of surveillance and situational awareness systems. Developed materials and materials processes to provide increased reliability and temperature capability while reducing power consumption, weight, cost, cooling, complexity, and size. Developed bulk and epitaxial materials with improved performance at and above the X-band wavelength region to enable improved power control devices. Evaluated sensor materials for defect density, doping, and stoichiometry through advanced process control techniques. \$2,908 Developed enabling infrared (IR) detector materials and process technologies to enable improved performance, affordability, and operational capability of surveillance and situational awareness systems. Evaluated alternative materials to fabricate IR detector focal plane arrays at very 										
(U)	\$2,006	long wavelengths. Demonstr wavelengths within spectral b manufacturing. Developed materials technolo Developed new nonlinear-opt	ated multi-la bands and be ogy to enhan tical materia	yered and h tween spectic ce the safety ls to replace	yperspectral ral bands. D and surviva state-of-the-	/multi-specti eveloped ne bility of airc art lithium r	ral IR detectors w processing crews agains hiobate for ir	or materials g techniques t heat seekin nfrared coun	that respond to improve g IR missile termeasure o	l to combinat yield in sma and laser th levices. Der	tions of ll lot reats. nonstrated
Р	roject 4348			Page	9 of 20 Pag	es			E>	hibit R-2A	(PE 0602102F)

	RDT&I	DATE February 2002		
BUDO 02 -	GET ACTIVITY • Applied Reseau	PROJECT 4348		
(U)	A. Mission Descript	on Continued		
(U)	FY 2001 (\$ in Thous	nds) Continued second generation, nonlinear absorbers as IR materials; d	esigned a gradient limiter device, transition damage	e tolerant, biological limiter host
(U)	\$610	ce sensor systems against laser valuated switchable (hologram) th, high optical density switchable		
(U)	\$9,932	Total		
(U)	FY 2002 (\$ in Thous	<u>nds)</u>		
(U)	\$8,163	Develop and demonstrate materials and process technolog improved performance, affordability, and operational cap non-lethal weapon systems. Develop and demonstrate m and power control components reliability and temperature size. Develop and demonstrate materials and materials p advanced radar, and electronic counter measures systems ultra-high power aircraft electrical generators enabling ai	ability for surveillance, targeting/tracking, situation aterials and materials processing technologies to en e capability while reducing power consumption, we rocesses to provide presently unattainable performa . Develop materials and materials process technologies rborne lethal and non-lethal directed energy weapon	acrowave components to provide nal awareness, and lethal and able increased power generation ight, cost, cooling, complexity, and nce for power control systems, gies for ultra-lightweight, ns in fighter-sized aircraft.
(U)	\$2,408	Develop and demonstrate infrared detector (IR) materials and operational capability of surveillance, tracking, targe space applications capable of detecting very long waveler materials that are responsive to multiple wavelengths with detector materials yield and affordability in small lots.	and materials processing technologies to enable im ting, and situational awareness systems. Develop a ngths. Develop the process control required for gro nin and between spectral bands. Validate new proc	aproved performance, affordability, Iternative IR detector materials for wth of complex IR detector essing techniques to improve IR
(U)	\$3,714	Develop and demonstrate materials technology to enhance missiles and laser threats. Demonstrate improved growth far-IR laser radiation for advanced infrared countermeasu enable high performance optical control of phased array r with large nonlinear absorption properties for the protect	e the safety and survivability of aircrews and relate and processing techniques for large nonlinear crys res. Develop and validate materials processing tec adar and satellite to satellite data links. Identify an on of personnel eyes, viewing systems, and night v	d assets against heat seeking tals for generating higher power hniques and materials that will d characterize organic materials ision goggles.
(U)	\$665	Develop enabling materials technologies to enhance the s	urvivability and mission effectiveness of aerospace	sensors, viewing systems, and
Р	roject 4348	Page 10	of 20 Pages	Exhibit R-2A (PE 0602102F)

	RDT&	DATE February 2002				
BUDO 02 -	GET ACTIVITY - Applied Resea	- PROJECT 4348				
(U)	A. Mission Descrip					
(U)	FY 2002 (\$ in Thous	ands) Continued night vision goggles against laser threats. Develop liq Evaluate high optical density, multiple wavelength sw	uid crystal materials for autonomous tunable filters to itchable filter stacks on curved substrates for agile lase	block agile laser wavelengths. er wavelength eye protection.		
(U)	\$14,950	Total	-			
(U)	FY 2003 (\$ in Thous	ands)				
(U)	\$3,077	improved performance, affordability, and operational of and non-lethal weapon systems. Demonstrate and vali- systems reliability and temperature capability while re transition materials and materials processes to provide electronic countermeasures. Scale up and transition m electrical generators enabling airborne lethal and non- Develop, demonstrate and transition infrared (IR) dete affordability, and operational capability of Air Force s process control required for growth of complex IR det bands. Transition new processing techniques to impro-	capability for Air Force surveillance, targeting/tracking date materials and materials processing technologies to ducing power consumption, weight, cost, cooling, com presently unattainable performance for power control laterials and materials process technologies for ultra-li lethal directed energy weapons in fighter-sized aircraft ctor materials and materials processing technologies to urveillance, tracking, targeting, and situational awarer ector materials that are responsive to multiple waveler we detector materials yield and affordability in small 1	g, situational awareness and lethal o enable increased Air Force aplexity, and size. Develop and systems, advanced radar, and ghtweight, ultra-high power aircraft t. o enable improved performance, aess systems. Demonstrate the agths within and between spectral ots. Investigate IR detector		
(U)	\$5,589	materials that provide enhanced real-time tracking cap Develop, demonstrate, and transition materials technol seeking missiles and laser threats. Develop growth an laser radiation for future infrared countermeasures. In demonstrate their performance in the Air Force Optical vision goggles	ability. logy to enhance the safety and survivability of aircrew d processing techniques for large nonlinear crystals fo corporate promising nonlinear absorbing materials into l Limiting Testbed for the protection of personnel eye	s and related assets against heat r generating higher power mid-IR o candidate host materials and s, viewing systems, and night		
(U)	 J) \$995 Develop and transition enabling materials technologies to enhance the survivability and mission effectiveness of Air Force sensors, viewing systems, and night vision goggles against laser threats. Demonstrate liquid crystal materials employed in autonomous tunable filters to black in the survivability and mission effective substrates. 					
(U)	\$12,616	Total				
Р	Project 4348	Page	11 of 20 Pages	Exhibit R-2A (PE 0602102F)		
			59			

	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 2002	
BUD(02 -	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT 4348
(U)	B. Project Change Summary Not Applicable		
(U) (U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0603112F, Advanced Materials for Weapon Systems PE 0602202F, Human Effectiveness Applied Research PE 0602204F, Aerospace Sensors. PE 0603231F, Crew Systems and Personnel Protection Technology. PE 0603211F, Aerospace Structures. PE 0602500F, Multi-disciplinary Space Technology This project has been coordinated through the Reliance process to harmonize	efforts and eliminate duplication.	
(U)	D. Acquisition Strategy Not Applicable.		
(U) (U)	E. Schedule Profile Not Applicable.		
F	Project 4348 Page	12 of 20 Pages	Exhibit R-2A (PE 0602102F)

	RDT	&E BUDGET ITEM JL	JSTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ary 2002
BUD0 02	SET ACTIVITY - Applied Rese	arch			PE NUMBE 060210	R AND TITLE	rials				PROJECT 4349
	COST	(\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4349	Materials Techn	ology for Sustainment	20,007	19,850	18,064	18,089	18,386	18,548	18,991	Continuing	твр
(U)	(U) <u>A. Mission Description</u> Develops and transitions materials and materials processing technologies to support operational Air Force mission areas by providing the ability to inspect the quality of delivered systems, transitioning more reliable and maintainable materials, establishing capability to detect and characterize performance threatening defects, characterizing materials processes and properties necessary for materials transition, and providing quick reaction support and failure analysis to the operational commands and repair centers. Develops repair techniques and nondestructive inspection/evaluation (NDI/E) methods that are needed for metallic and non-metallic structures, coatings, corrosion control processes, and to support integration of composite structures for aerospace systems. Various NDI/E methods are essential to ensure optimum quality in the design and production of aircraft, propulsion, and missile systems. These NDI/E methods are also essential to monitor and detect the operational initiated demage and/or deterioration due to aging of operational systems.							spect the quality g defects, perational l non-metallic e essential to and detect the			
(U) (U)	<u>FY 2001 (\$ in Tho</u> \$4,301	 <u>FY 2001 (\$ in Thousands)</u> \$4,301 Developed and transitioned NDI/E technology to identify and characterize damage in complex, low-observable materials and structures, and to inspect and maintain integrity of aging aerospace structures and propulsion systems. Transitioned enhanced laser-generated ultrasound capabilities to detect the onset of hidden corrosion between metallic structural elements. Initiated development of an NDI/E response computer simulation model for integrated product design. Developed and designed laboratory scale capability to evaluate remote inspection capabilities for crack detection within complex structures. Evaluated methods to nondestructively measure near surface (100 micron) residual stress depth 									
(U)	\$2,911	2,911 Developed and transitioned enabling technologies to reduce the Air Force maintenance burden due to low-observable requirements. Established baseline capability for NDI/E point inspection devices to verify repair quality. Assembled an integrated low-observable repair kit. Demonstrated high temperature and/or ultraviolet gap sealants and conductive elastomers. Developed ultrasonically applied and/or removed thermonlastic radar absorbing material (RAM) repairs high temperature RAM coating repairs, and radar absorbing structure field level repairs									
(U)	\$4,627	Developed and transitioned su and structural failure analysis organizations. Transitioned ϵ testing techniques needed for	upport capal s of compone electrostatic c analyzing s	bilities, infor ents. Perfori discharge pr structural fail	mation, and med failure a rotection mat lures of repla	processes to inalysis and terials techno acement mat	resolve pro materials in ologies for s erials for ag	blems in the vestigations pace and lov ing Air Forc	use of mate for field, acc v-observable e systems.	rials and pro quisition, and applications	vide electronic 1 depot s. Evaluated
(U)	\$8,168	Developed and transitioned sy	upport capal	bilities, infor	rmation, and	processes to	resolve pro	blems in the	use of mate	rials, in the r	epair of aircraft
F	roject 4349			Page	: 13 of 20 Pa	ges			E	xhibit R-2A	(PE 0602102F)

	RDT&E	February 2002	
BUDO 02 -	UDGET ACTIVITY PE NUMBER AND TITLE 2 - Applied Research 0602102F Materials		PROJECT 4349
(U)	A. Mission Descripti	on Continued	
(U)	FY 2001 (\$ in Thousa	nds) Continued structures, and to reduce aircraft corrosion. Established residual stresses baseline criteria of High Cycle Fat turbine engine blade materials. Evaluated advanced composite materials compatibility with laser effluents a materials for high energy chemical oxygen-iodine laser devices. Developed improved gap-filler materials for on-aircraft processed adhesive and patch repair of high-temperature composite aircraft structures. Develope and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Valid corrosion.	ique and foreign object damage in s an alternative to metallic or low-observable platforms and test d capabilities to evaluate corrosion dated technical understanding of
(U)	\$20,007	Total	
(U) (U) (U)	<u>FY 2002 (\$ in Thousa</u> \$4,443 \$3,128	nds) Develop non-destructive inspection/evaluation (NDI/E) technology to identify and characterize damage in co and structures. Develop inspection technology for aging aerospace structures and propulsion systems. Ident characterize multi-site damage and cracks in large area, aging structures. Identify computer simulations and response which will enable the development of improved inspections in a virtual environment to permit the option potential of new corrosion and crack detection NDI/E methods. Develop transition methods to measure resident extend the service life of turbine engine rotors. Identify and develop methods to detect and characterize the engine components. Identify NDI/E methods to characterize the low-observable properties of paints and coa Develop enabling technologies to reduce the Air Force maintenance burden due to low-observable requirem point inspection devices and verify repair quality. Evaluate an integrated low-observable repair kit. Validat ultraviolet gap sealants and conductive elastomers. Demonstrate ultrasonically applied and/or removed there (RAM) repairs, high temperature RAM coating repairs, and radar absorbing structure field level repairs.	omplex, low-observable materials tify methods to rapidly detect and models of NDI/E technique depots to rapidly assess the dual stress to allow depots to safely severity of fretting fatigue in atings during and after application. ents. Develop capability for NDI/E e high temperature and/or moplastic radar absorbing material
(U)	\$4,778	Develop and transition support capabilities, information, and processes to resolve problems in the use of mat structural failure analysis of components. Perform failure analysis and materials investigations for field, acq Continue certification and transition of emerging electrostatic discharge protection materials technologies ar low-observable applications. Continue experimental evaluation of testing techniques needed for analyzing s materials for aging Air Force systems.	terials and provide electronic and quisition, and depot organizations. Ind techniques for space and tructural failures of replacement
(U) P	\$7,501	Develop support capabilities, information, and processes to resolve problems in the use of materials, in the reduce aircraft corrosion. Validate residual stresses baseline criteria of high cycle fatigue foreign object dan Page 14 of 20 Pages	epair of aircraft structures and to hage in turbine engine blade Exhibit R-24 (PE 06021025)
Р	roject 4349	Page 14 of 20 Pages	Exhibit R-2A (F

	RDT&	it) DATE February 2002						
BUDO 02 -	GET ACTIVITY - Applied Resea	PROJEC 4349	Т					
(U)	A. Mission Descrip							
(U)	FY 2002 (\$ in Thou	sands) Continued materials. Demonstrate advanced composite materials compatibility with laser efflue chemical oxygen-iodine laser devices. Evaluate improved gap-filler materials for low adhesive and patch repair of high-temperature composite aircraft structures. Demons resistance of new and emerging materials used in operationally fielded Air Force syst management procedures.	nts as an alternative to metallic materials for high energy v-observable platforms and test on-aircraft processed trate capabilities to evaluate corrosion and erosion ems. Establish baseline for improved corrosion	7				
(U)	\$19,850	Total						
(U) (U)	<u>FY 2003 (\$ in Thou</u> \$5,088	sands) Develop non-destructive inspection/evaluation (NDI/E) technology to identify and ch materials and structures. Develop inspection for aging aerospace structures and propu characterize multi-site damage and cracks in large area, aging structures. Evaluate co evaluation technique response which will enable the development of improved inspec rapidly assess the potential of new corrosion and crack detection NDE methods. Eval fratting fatigue in angine components. Evaluate NDE/I methods to characterize the I	aracterize damage in complex, low-observable (LO) alson systems. Evaluate methods to rapidly detect and omputer simulations and models of non-destructive stions in a virtual environment to permit the depots to luate methods to detect and characterize the severity of O properties of paints and coatings during and after					
(U)	\$2,588	application. Develop and transition enabling technologies to reduce the Air Force maintenance bu NDE point inspection devices and verify repair quality. Demonstrate an integrated Lu ultraviolet gap sealants and conductive elastomers. Transition ultrasonically applied a (RAM) repairs, high temperature RAM coating repairs, and radar absorbing structure	rden due to LO requirements. Validate capability for O repair kit. Transition high temperature and/or and/or removed thermoplastic radar absorbing material field level repairs					
(U)	 (RAM) repairs, high temperature RAM coating repairs, and radar absorbing structure field level repairs. \$4,089 Develop support capabilities, information, and processes to resolve problems in the use of materials and provide electronic and structural failure analysis of components. Perform failure analysis and materials investigations for field, acquisition, and depot organizations. Continue certification and transition of emerging electrostatic discharge (ESD) protection materials technologies and techniques for LO applications. Continue experimental evaluation of testing techniques needed for analyzing structural failures of replacement materials for aging Air Force 							
(U)	\$6,299	Develop support capabilities, information, and processes to resolve problems in the us reduce aircraft corrosion. Publish residual stresses baseline criteria of high cycle fatig materials. Transition advanced composite materials compatibility with laser effluents	se of materials, in the repair of aircraft structures and to gue foreign object damage in turbine engine blade s as an alternative to metallic materials for high-energy					
Р	Project 4349	Page 15 of 20 Pages	Exhibit R-2A (PE 0602102F	=)				

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) February 2002									
виро 02 -	BET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT 4349							
(U) (U) (U)	A. Mission Description Continued FY 2003 (\$ in Thousands) Continued chemical oxyge adhesive and paresistance of ne management pr \$18,064 Total B. Project Change Summary	en-iodine laser devices. Transition improved gap-filler materials for LO platforms and demon atch repair of high-temperature composite aircraft structures. Demonstrate capabilities to eval aw and emerging materials used in operationally fielded Air Force systems. Publish baseline f occedures.	Istrate on-aircraft processed luate corrosion and erosion For improved corrosion							
(U) (U) (U) (U) (U) (U) (U)	Not Applicable. <u>C. Other Program Funding Summar</u> Related Activities: PE 0603112F, Advanced Materials for PE 0603211F, Aerospace Structures This project has been coordinated thro <u>D. Acquisition Strategy</u>	ry (\$ in Thousands) Weapons Systems. ugh the Reliance process to harmonize efforts and eliminate duplication.								
(U) (U)	Not Applicable. <u>E. Schedule Profile</u> Not Applicable.									
Р	roject 4349	Page 16 of 20 Pages	Exhibit R-2A (PE 0602102F)							

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) DATE February 2002										iry 2002
BUDGET ACTIVITY PE NUMBER AND TITLE 02 - Applied Research 0602102F Materials											PROJECT 4915
COST (\$ in Thousands)FY 2001 ActualFY 2002 EstimateFY 2003 EstimateFY 2004 										Total Cost	
4915	Deployed Air Base	Technology	0	1,412	2,345	2,236	2,515	2,582	2,647	Continuing	TBD
Note	In FY 2002, Project	4397, efforts transferred from P	E 0602102F	, into Projec	ct 4915.						
(U)) <u>A. Mission Description</u> Supports the Air Expeditionary Forces (AEF) through development of new technologies for deployable airbase systems to reduce airlift, setup times, manpower requirements, and sustainment costs. Develops efficient and cost-effective technologies to provide force protection and survivability, including fire fighting, to AEF deployed warfighters. Develops affordable, deployable technologies that ensure military readiness, maintain aerospace missions, support weapon systems sustainment, and ensure deployability.										
(U)) <u>FY 2001 (\$ in Thousands)</u>										
(U) (U)	\$0 \$0	This effort was performed in I Total	PE 0602201	F, Aerospac	e Flight Dyn	amics, Proje	ect 4397, All	Base Techn	iology, (\$4.1	5/ million).	
(U) (U)	 <u>FY 2002 (\$ in Thousands)</u> S885 Develop new deployable airbase systems to reduce airlift, setup times, manpower requirements, and sustainment costs in support of AEF technologies. Develop lightweight, flexible solar cell technologies that improve operating efficiency and reduce sustainment costs of airmobile systems. Develop lightweight, rapidly assembled matting systems to enable rapid expansion of aircraft parking at deployment locations. 										
(U)	 \$110 \$110 bevelop effective advanced fire fighting agents and equipment to protect deployed warrighters. Develop affordable, deployable technologies that ensure military readiness, maintain aerospace missions, support weapons systems sustainment, and ensure deployablity. Develop safe, cost-effective disposal of problem AEF wastes for low-observable material waste 										
(U)	 \$417 Develop efficient and cost-effective technologies to provide force protection and survivability to AEF deployed warfighters and materials. Develop atmospheric threat prediction models and deployable concers systems to protect AEE forces from toxic inductrial materials. 										
(U)	J) \$1,412 Total										
Ρ	roject 4915			Page	17 of 20 Pag	ges			Ex	hibit R-2A	(PE 0602102F)

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) DATE February 2002									
BUD0 02 ·	GET ACTIVITY - Applied Resear	PROJECT 4915								
(U)	A. Mission Descript	on Continued								
(U) (U)	FY 2003 (\$ in Thous \$1,697	<u>ands</u>) Develop new deployable airbase systems to reduce airlift, setup times, manpower requirements and sustainn technologies. Develop an integrated deployable fuel cell, solar power, and heat pump system that decreases between failure, increases operating efficiency, and reduces sustainment costs for air mobile systems perform	nent costs in support of AEF maintenance and mean time nance.							
(U)	\$158	Develop affordable, deployable technologies that ensure military readiness, maintain aerospace missions, su and ensure deployablity. Continue development of safe, cost-effective disposal of problem Air Expeditionar low-observable material waste treatment	pport weapon systems sustainment, cy Force (AEF) wastes for							
(U)	 10w-observable material waste treatment. \$490 bevelop cost-effective technologies to provide force protection and survivability to AEF deployed warfighters and materials. Continue development of atmospheric threat prediction models and deployable sensors systems to protect AEF forces from toxic industrial materials. Develop offective advanced fire fighting agents and equipment and advanced blest protection meterials to protect deployed warfighters 									
(U)	\$2,345	Total								
(U)	<u>B. Project Change S</u> Not Applicable.	ummary								
(U) (U) (U) (U)	C. Other Program F Related Activities: PE 0603112F, Advan This project has been	unding Summary (\$ in Thousands) ced Materials for Weapon Systems coordinated through the Reliance process to harmonize efforts and eliminate duplication.								
(U)	D. Acquisition Strate Not Applicable.	<u>ev</u>								
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.									
F	Project 4915	Page 18 of 20 Pages	Exhibit R-2A (PE 0602102F)							

BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT 02 - Applied Research 0602102F Materials 5015 COST (\$ in Thousands) FY 2001 Actual FY 2002 Estimate FY 2003 Estimate FY 2006 Estimate FY 2007 Estimate FY 2007 Estimate FY 2007 Estimate Cost to Complete Total Cost 5015 Rocket Materials Technology 0 0 1,340 1,438 1,694 1,812 1,931 Continuing T Note: In FY 2003, space unique tasks in Project 5015 will be transferred to PE 0602500F, Project 5025, in conjunction with the Space Commission recommendation to consolidate all space unique activities. In FY 2003, non-space unique tasks (and other aerospace materials related technology) will be transferred into this project from PE 0602203F, Project 4847. Image: Complete Activities and processing technology aerospace propulsion technologies to dramatically improve affordability performance, and reliability of current and future aerospace engine applications. The components of liquid-fuel engines that advanced materials can significantly impact include lightweight ducts, turbo pumps, injectors, and nozzles sub-systems. The material advancements in these aerospace systems will provide lighter weight, performance and cost reduction enhancements for overall aerospace engine applications. This project will develop material property databases and initiate the demonstration of suitability for new materials application using representative geometry and processing conditions for the intended aerospace engine components. Image: PY 2001 (\$ in T	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) February 2002									
COST (\$ in Thousands) FY 2001 Actual FY 2002 Estimate FY 2003 Estimate FY 2004 Estimate FY 2005 Estimate FY 2006 Estimate FY 2007 Estimate Cost to Complete Total Cost 5015 Rocket Materials Technology 0 0 1,340 1,438 1,694 1,812 1,931 Continuing T Note: In FY 2003, space unique tasks in Project 5015 will be transferred to PE 0602500F, Project 5025, in conjunction with the Space Commission recommendation to consolidate all space unique activities. In FY 2003, non-space unique tasks (and other aerospace materials related technology) will be transferred into this project from PE 0602203F, Project 4847. Image: Space	BUDGET ACTIVITY 02 - Applied Research	BUDGET ACTIVITY F 02 - Applied Research								PROJECT 5015
5015 Rocket Materials Technology 0 0 1,340 1,438 1,694 1,812 1,931 Continuing T Note: In FY 2003, space unique tasks in Project 5015 will be transferred to PE 0602500F, Project 5025, in conjunction with the Space Commission recommendation to consolidate all space unique activities. In FY 2003, non-space unique tasks (and other aerospace materials related technology) will be transferred into this project from PE 0602203F, Project 4847. (U) A.Mission Description Develops advanced pervasive materials and processing technology aerospace propulsion technologies to dramatically improve affordability performance, and reliability of current and future aerospace engine applications. The components of liquid-fuel engines that advanced materials can significantly impact include lightweight ducts, turbo pumps, injectors, and nozzles sub-systems. The material advancements in these aerospace systems will provide lighter weight, performance and cost reduction enhancements for overall aerospace engine applications. This project will develop material property databases and initiate the demonstration of suitability for new materials application using representative genery and processing conditions for the intended aerospace engine complexity. Visit develop material property databases and initiate the demonstration of suitability for new materials application using representative genery and processing conditions for the intended aerospace engine complexity. (U) FY 2001 (\$ in Thousands) Visit develop material property databases and initiate the demonstration of suitability for new materials application using representative genery and processing conditions for the i	COST (\$ in Thousands)FY 2001 ActualFY 2002 EstimateFY 2003 EstimateFY 2004 EstimateFY 2005 EstimateFY 2006 Estimate								Cost to Complete	Total Cost
 Note: In FY 2003, space unique tasks in Project 5015 will be transferred to PE 0602500F, Project 5025, in conjunction with the Space Commission recommendation to consolidate all space unique activities. In FY 2003, non-space unique tasks (and other aerospace materials related technology) will be transferred into this project from PE 0602203F, Project 4847. (U) A. Mission Description Develops advanced pervasive materials and processing technology aerospace propulsion technologies to dramatically improve affordability performance, and reliability of current and future aerospace engine applications. The components of liquid-fuel engines that advanced materials can significantly impact include lightweight ducts, turbo pumps, injectors, and nozzles sub-systems. The material advancements in these aerospace systems will provide lighter weight, performance and cost reduction enhancements for overall aerospace engine applications. This project will develop material property databases and initiate the demonstration of suitability for new materials application using representative geometry and processing conditions for the intended aerospace engine components. (U) <u>FY 2001 (\$ in Thousands)</u> (U) <u>FY 2002 (\$ in Thousands)</u> (U) <u>S0</u> No Activity (U) S0 	5015 Rocket Materials Technology	0	0	1,340	1,438	1,694	1,812	1,931	Continuing	TBD
 (U) A. Mission Description Develops advanced pervasive materials and processing technology aerospace propulsion technologies to dramatically improve affordability performance, and reliability of current and future aerospace engine applications. The components of liquid-fuel engines that advanced materials can significantly impact include lightweight ducts, turbo pumps, injectors, and nozzles sub-systems. The material advancements in these aerospace systems will provide lighter weight, performance and cost reduction enhancements for overall aerospace engine applications. This project will develop material property databases and initiate the demonstration of suitability for new materials application using representative geometry and processing conditions for the intended aerospace engine components. (U) <u>FY 2001 (\$ in Thousands</u>) (U) <u>FY 2002 (\$ in Thousands</u>) (U) <u>S0</u> No Activity (U) <u>S0</u> No Activity (U) <u>S0</u> No Activity (U) <u>S0</u> No Activity (U) <u>S0</u> Total 	Note: In FY 2003, space unique tasks in Project 5015 will be consolidate all space unique activities. In FY 2003, non-space 0602203F, Project 4847.	Note: In FY 2003, space unique tasks in Project 5015 will be transferred to PE 0602500F, Project 5025, in conjunction with the Space Commission recommendation to consolidate all space unique activities. In FY 2003, non-space unique tasks (and other aerospace materials related technology) will be transferred into this project from PE 0602203F, Project 4847.								
(U) FY 2001 (\$ in Thousands) (U) \$0 No Activity (U) \$0 Total (U) \$0 No Activity (U) \$0 No Activity (U) \$0 No Activity (U) \$0 No Activity (U) \$0 Total	U) <u>A. Mission Description</u> Develops advanced pervasive materials and processing technology aerospace propulsion technologies to dramatically improve affordability performance, and reliability of current and future aerospace engine applications. The components of liquid-fuel engines that advanced materials can significantly impact include lightweight ducts, turbo pumps, injectors, and nozzles sub-systems. The material advancements in these aerospace systems will provide lighter weight, performance and cost reduction enhancements for overall aerospace engine applications. This project will develop material property databases and initiate the demonstration of suitability for new materials application using representative geometry and processing conditions for the intended aerospace engine components.									
 (U) <u>FY 2002 (\$ in Thousands)</u> (U) \$0 No Activity (U) \$0 Total 	 (U) <u>FY 2001 (\$ in Thousands</u>) (U) \$0 No Activity (U) \$0 Total 									
	 (U) <u>FY 2002 (\$ in Thousands</u>) (U) \$0 No Activity (U) \$0 Total 	 U) <u>FY 2002 (\$ in Thousands)</u> U) \$0 No Activity U) \$0 Total 								
 (U) <u>FY 2003 (\$ in Thousands</u>) (U) \$1,340 Develop and demonstrate pervasive materials and processing technology for aerospace engine components and sub-components to dramatically improve affordability, performance, and reliability of current and future Air Force aerospace systems. Evaluate chemistry/heat treatment combination for new compatible alloys for aerospace propulsion housing components. Identify and develop pervasive zero erosion materials for multiple aerospace engine and missile applications. Identify and evaluate pervasive high temperature catalyst materials that will enable the use of high performance monopropellants for aerospace propulsion systems. (U) \$1,340 Total 										
Project 5015 Page 19 of 20 Pages Exhibit R-2A (PE 0602102F	Project 5015		Page	19 of 20 Pag	ges			E>	khibit R-2A	PE 0602102F)

RDT&E BUDGET ITEM JUSTIF	DATE February 2002	
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT 5015
(U) <u>B. Project Change Summary</u> Not applicable.		
 (U) <u>C. Other Program Funding Summary (\$ in Thousands</u>) (U) Related Activities: PE 0602500F, Multi-disciplinary Space Technology PE 0602102F, Materials PE 0602302F, Aerospace Propulsion 		
(U) <u>D. Acquisition Strategy</u> Not Applicable.		
 (U) <u>E. Schedule Profile</u> (U) Not applicable. 		
Project 5015	Page 20 of 20 Pages	Exhibit R-2A (PE 0602102F)

PE TITLE: Aerospace Vehicle Technologies

	RDT&E BUDGET ITEM J	USTIFIC	CATION	SHEET	(R-2 E)	(hibit)	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								
BUDGE ⁻ 02 - /	r activity	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies													
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost					
	Total Program Element (PE) Cost	51,909	98,785	78,789	108,212	106,663	109,238	109,540	Continuing	TBD					
2401	Structures	47,859	32,791	26,292	42,354	42,999	43,266	42,766	Continuing	TBD					
2403	Flight Controls and Pilot-Vehicle Interface	0	35,236	25,585	34,398	32,531	33,322	32,598	Continuing	TBD					
2404	Aeromechanics and Integration	0	29,570	26,912	31,460	31,133	32,650	34,176	Continuing	TBD					
4397	Air Base Technology	4,050	1,188	0	0	0	0	0	Continuing	TBD					
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	Continuing	твр					

Note: In FY 2002, selected efforts from Project 2401 have transferred into Projects 2403 and 2404 within this PE. In FY 2002, Project 4397 efforts transferred to PE 0602102F, Project 4915. 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.

A. Mission Description (U)

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 2002, Congress added \$0.7 million for advanced comprehensive engineering simulator development and \$2.9 million for weapon systems logistics, deployed base systems technology, and force protection.

B. Budget Activity Justification (U)

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.

Page 1 of 14 Pages

Exhibit R-2 (PE 0602201F

	RDT&E BUDGET ITEM JUSTIFIC	DATE Febru	DATE February 2002		
BUDO 02 -	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602201F Aerospace	ce Vehicle Te	chnologies	
(U)	C. Program Change Summary (\$ in Thousands)				
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	Total Cost
(U)	Previous President's Budget	53,183	97,465	64,274	
(U)	Appropriated Value	53,675	99,415		
(U)	Adjustments to Appropriated Value		12 0		
	a. Congressional/General Reductions		-630		
	b. Small Business Innovative Research	-1,274			
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram	102			
	e. Rescissions	-492		14515	
(\mathbf{U})	Adjustments to Budget Years Since FY 2002 PBR	51.000	00 705	14,515	
(0)	Current Budget Submit/FY 2003 PBR	51,909	98,785	/8,/89	IBD
	Changes to this program since the previous President's Budget are range strike.	due to increased funding for technologie	es in space lift and	next generation air vehi	cles for long
		Page 2 of 14 Pages		Exhibit R-2	(PE 0602201F)

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) February 2002									ry 2002	
BUDGET ACTIVITY PE NUMBER AND TITLE 02 - Applied Research 0602201F Aerospace Vehicle Tec									chnologi	es	PROJECT 2401
	COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2401	Structures		47,859	32,791	26,292	42,354	42,999	43,266	42,766	Continuing	TBD
(U)	 <u>A. Mission Description</u> This project develops advanced structures concepts to exploit new materials and fabrication processes and investigates new structural concepts and design techniques. Resulting technologies strengthen and extend the life of current and future manned and unmanned aerospace vehicle structures. Payoffs to the warfighter include reduced weight and cost, as well as improved operability and maintainability of aerospace vehicles. 										
(U) (U)	FY 2001 (\$ in Thousands) \$3,742 Developed methods to predict and to suppress structural damage due to high cycle fatigue that reduce operations and support costs and provide higher aircraft availability. Continued development of durability patches for structures experiencing premature failure due to high cycle fatigue. Continued technology improvements of airframe structural vibration suppression techniques which delay the onset of high cycle										
(U)	\$5,148	Tatigue failures. Developed and demonstrated new control techniques to enable safe, highly autonomous mixed-fleet and multi-unmanned air vehicle operations for increased combat effectiveness. Continued unmanned aerospace vehicle development to ensure safe operation and allow precision close operations of mixed manned and unmanned air vehicles. Developed adaptive flight control algorithms for autonomous vehicle operations.									
(U)	\$1,828	Continued development of advanced system for automatic onnamed Air Venicle in-Hight feituring. Continued development of composite and metallic concepts that reduce manufacturing costs of future air vehicles. Initiated development of Analytical Certification Methodologies for unitized structures to ensure transition of advanced concepts and manufacturing processes to future airframe designs. Continued development of integrated multidisciplinary design methodologies that enhance affordability and decrease unharehility of future agreeness vehicles.									
(U)	\$3,163	Developed new flight control design methods and criteria that provide air combat advantage by increasing performance and decreasing vulnerability and cost. Initiated development of new intelligent/learning reconfigurable controller to enable continued air vehicle operation in event of damage or failure, and develop a new air vehicle flight control learning concept									
(U)	\$3,343	Developed advanced flight control technology to enable aircraft-like operations for affordable on-demand military access to space. Developed technology concepts for integration of vehicle management system with vehicle health management/prognostics. Completed aerospace vehicle requirements definition study and conceptual design									
(U)	\$2,879	Continued development of a s	signature-co	mpatible, int	egrated high	lift device t	hat will imp	rove aerody	namic perfo	rmance and s	survivability
F	Project 2401			Page	3 of 14 Pag	es			E>	hibit R-2A	(PE 0602201F)

BUDGET ACTIVITY PE NUMBER AND TITLE 02 - Applied Research 0602201F Aerospace Vehicle Technologies (U) A. Mission Description Continued (U) FY 2001 (\$ in Thousands) Continued (U) FY 2001 (\$ in Thousands) Continued with lower cost of ownership than conventional flight control devices. Performed analytical design of subscale aerosp	PROJECT 2401
 (U) <u>A. Mission Description Continued</u> (U) <u>FY 2001 (\$ in Thousands) Continued</u> with lower cost of ownership than conventional flight control devices. Performed analytical design of subscale aerosp future powered testing and analysis 	
(U) <u>FY 2001 (\$ in Thousands) Continued</u> with lower cost of ownership than conventional flight control devices. Performed analytical design of subscale aerosp future powered testing and analysis	
	pace vehicle model for
 (U) \$3,786 Developed computational tools and techniques for predicting and optimizing aerodynamic and structural performance unmanned aerospace vehicles. Continued development of next generation, multi-disciplinary optimization computer of aerodynamics, structures, thermal management, signatures, and flight controls. Completed development of fully assoc multi-disciplinary design architecture and demonstrate capability to employ high fidelity analyses earlier in aircraft de and evaluate cost of advanced configurations for unmanned air vehicles. 	e of advanced manned and design code integrating ociative object-oriented esign to rapidly synthesize
 (U) \$4,831 Developed and demonstrated affordable aerospace vehicle aerodynamic technologies that increase aerospace vehicle printer investigation into techniques to generate and control plasma flow field over hypersonic vehicles. This will improve hymeneuverability of transatmospheric vehicles and save weight over traditional reaction control and aerodynamic control 	performance. Initiated 1ypersonic trol surface approaches.
(U) \$2,698 Evaluated the integration of multifunctional structures that tailor structural response and integrate subsystem functional level manufacturing costs and increase tactical performance of future aerospace vehicles. Initiated development of ful integrated with a low frequency multifunctional antenna to increase radio frequency performance and reduce weight.	ality to reduce system all wing span structurally
(U) \$3,155 Improved durability of existing and future aerospace vehicle structures by developing technologies that incorporate ad as passive and active cooling to withstand the extreme environments of high temperatures, vibrations, and acoustic no increase life of aerospace vehicle structures. Concepts under development consisted of design, fabrication, and assess composite and metallic aerospace vehicle structures.	dvanced materials as well bise to reduce cost and sment of high temperature
(U) \$8,290 Investigated modification and repair techniques to retrofit fail-safety into aging aircraft to increase availability and red support costs. Developed composite and metallic bonded repair techniques which provide for damage tolerance where Investigated low-cost structural modifications to aging systems which provide fail-safety in critical areas of the aircraft	duce operations and re none now exists.
 (U) \$2,996 Developed advanced analytical methods for analysis of unitized structures and certification of structural components with development time and cost of aircraft. Initiated exploration of damage initiation and propagation models for unitized Developed analytical methods for certification of aging aircraft repairs and structural modifications. 	which reduce I metallic structure.
(U) \$2,000 Expanded aeronautical research efforts to focus on developing technologies for integrated design solutions for optimal and sensor performance of future aircraft.	al signature, aerodynamics,
(U) \$47,859 Total	
Project 2401Page 4 of 14 PagesExhibit	bit R-2A (PE 0602201F)

	RDT&E	DATE February 2002		
вирс 02 -	GET ACTIVITY • Applied Resear	ch PE	NUMBER AND TITLE 02201F Aerospace Vehicle Techno	PROJECT 2401
(U)	A. Mission Descripti	on Continued		
(U)	FY 2002 (\$ in Thousa	<u>nds)</u>		
(U)	\$2,859	Develop economic service life analysis for current and future Continue development of unitized structural concepts and revulnerability for current and future aerospace vehicles. Inclusoftware.	The aircraft, enhancing capability, component replation multidisciplinary optimization methodologies that corporate newly developed analysis tools into life p	cement, and technology direction. enhance affordability and decrease prediction and failure analysis
(U)	\$5,080	Develop analytical certification methodologies for the inco legacy aircraft components and future airframe designs. In aeroelastic loads with high fidelity models.	rporation of advanced methods, concepts, and man prove the air-worthiness certification process for	nufacturing technologies into aircraft subjected to dynamic
(U)	\$6,941	Continue development of structural concepts and design an functions to reduce cost and increase the survivability of fu subsystems hardware, and antennae contained within loadb	and analysis methods that enable the integration of s sture systems. Concepts include adaptive structure bearing structure.	structure with other airframe es for varying moldline,
(U)	\$17,911	Develop technologies that incorporate advanced materials a Technologies will improve durability of existing and future include advanced, durable, all-weather thermal protection s integrated thermal protection systems, hot primary structure cryogenic/non-cryogenic tank structures.	as well as passive and active cooling to withstand e aerospace vehicle structures resulting in reduced systems, attachment techniques, vehicle health mo es, hybrid structures, unitized structures, joining c	extreme flight environments. cost and increased life. Concepts nitoring and health management, oncepts, and
(U)	\$32,791	Total		
(U)	FY 2003 (\$ in Thousa	nds)		
(U)	\$6,896	Develop economic service life analysis for current and future Continue development of unitized structural concepts and revulnerability for current and future aerospace vehicles. Inclusoftware.	The aircraft, enhancing capability, component repla multidisciplinary optimization methodologies that corporate newly developed analysis tools into life p	cement, and technology direction. enhance affordability and decrease prediction and failure analysis
(U)	\$2,373	Develop analytical certification methodologies for the inco legacy aircraft components and future vehicle designs. Imp aeroelastic loads with high fidelity models.	rporation of advanced methods, concepts, and man prove the air-worthiness certification process for a	nufacturing technologies into ircraft subjected to dynamic
(U)	\$2,292	Continue development of structural concepts and design an functions to reduce cost and increase survivability of future	ad analysis methods that enable the integration of s e systems. Concepts include adaptive structures for	structure with other airframe or varying moldline, subsystems
Р	roject 2401	Page 5 of	14 Pages	Exhibit R-2A (PE 0602201F)

02 - /	ET ACTIVITY Applied Resear	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Tec	PROJECT hnologies 2401								
(U)	(U) <u>A. Mission Description Continued</u>										
(U) (U)	<u>FY 2003 (\$ in Thousa</u> \$14,731	nds) Continued hardware, and antennae contained within loadbearing structures. Develop technologies that incorporate advanced materials as well as passive and active cooling to withs Technologies will improve durability of existing and future aerospace vehicle structures resulting in red include advanced, durable, all weather primary structures, hybrid structures, unitized structures, ioining	tand extreme flight environments. uced cost and increased life. Concepts								
	tank structures.		concepts, and cryogenic/non-cryogenic								
(U)	\$26,292	Total									
(U)	B. Project Change Su Not Applicable.	<u>immary</u>									
 (U) 9 (U) 11 	C. Other Program Funding Summary (\$ in Thousands)Related Activities:PE 0602102F, MaterialsPE 0603112F, Advanced Materials for Weapon SystemsPE 0603211F, Aerospace Technology Dev/DemoPE 0603333F, Unmanned Air Vehicle Dev/DemoThis project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.										
(U) <u>I</u> N	D. Acquisition Strategy Not Applicable.										
(U) <u>I</u> (U) 1	E. Schedule Profile Not Applicable.										
Pro	oject 2401	Page 6 of 14 Pages	Exhibit R-2A (PE 0602201F)								
	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE	Februa	ry 2002
----------------------	--	---	-------------------	---------------------	---------------------	---------------------	---------------------	---------------------	---------------------	---------------------	------------------------
виро 02 -	GET ACTIVITY	ch			PE NUMBE 060220	R AND TITLE	space Ve	hicle Te	chnologi	es	PROJECT 2403
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2403	Flight Controls and	Pilot-Vehicle Interface	0	35,236	25,585	34,398	32,531	33,322	32,598	Continuing	TBD
Note trans (U)	Note: Beginning in FY 2002, selected efforts from Project 2401 have been moved into Projects 2403 and 2404. In FY 2003, the space unique tasks in Project 2403 will be transferred to PE 0602500F, Project 5030, in conjunction with the Space Commission recommendation to consolidate all space unique activities. (U) <u>A. Mission Description</u>										
	This project develops technology to enable maximum affordable capability from manned and unmanned aerospace vehicles. Advanced flight control technologies are developed for maximum vehicle performance throughout the flight envelope and simulated in virtual environments. Resulting technologies contribute significantly towards the development of reliable autonomous unmanned air vehicles, space access systems with aircraft-like operations, and extended-life legacy aircraft. Payoffs to the warfighter include enhanced mission effectiveness; optimized flight safety; increased survivability; improved maintenance; and decreased size, weight, and cost. Leverages a network of synthetic environments for evaluation of advanced concepts. Note: In FY 2002, Congress added \$.7 million for advanced comprehensive engineering simulator.										
(U) (U) (U)	<u>FY 2001 (\$ in Thouse</u> \$0 \$0	ands) Effort moved to Project 2401 Total									
(U) (U)	 <u>FY 2002 (\$ in Thousands</u>) \$3,982 Develop and assess advanced control mechanization technologies to provide highly reliable operation for manned and unmanned systems at significantly reduced size, weight, and cost. Complete laboratory demonstrations of fiber optic-based vehicle management system and optical air data system components. Develop validation and verification techniques for complex, adaptive, and autonomous control software. Assess 										
(U)	\$8,938	Develop and assess control automation techniques and algorithms to enable the safe and interoperable application for formations of manned and unmanned vehicle systems. Concepts will also provide mission responsiveness and adaptability for improved operational effectiveness of manned and unmanned systems. Continue development and test of intelligent-agent software providing package-level coordination and health monitoring and management for aerospace vehicles. Continue the simulation analysis of automated aerial refueling system technologies. Complete analysis and specification of on-board sensor suite for safe operation of unmanned vehicles in proximity of other manned and unmanned air vehicles.									
Р	roject 2403			Page	7 of 14 Pag	es			Ex	hibit R-2A	(PE 0602201F)

	RDT&E	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								
вирс 02 -	GET ACTIVITY - Applied Resear	PE NUMBER AND TITLE O602201F Aerospace Vehicle Techn	ologies 2403							
(U)	A. Mission Descripti	ion Continued								
(U)	FY 2002 (\$ in Thousa	ands) Continued								
(U)	 \$6,657 Develop new flight control design methods and criteria that provide air combat advantage by increasing performance and decreasing vulnerability and cost. Continue development of new intelligent/learning reconfigurable controller to enable continued air vehicle operation in the event of damage or failure. Integrate with on-line route planner and systems diagnostics for unmanned vehicle fault tolerant, autonomous operations. Develop integrated adaptive guidance and control systems for high and ultra-high speed aerospace vehicles. 									
(U)	 \$6,199 Develop advanced flight control technology to enable aircraft-like operations for affordable on-demand military access to space. Continue development and analysis of affordable, lightweight vehicle/health monitoring and management systems, integrated with critical guidance and navigation algorithms for high and ultra-high speed aerospace vehicles. Develop parameters for health monitoring and management data collection, and develop prognostic algorithms. 									
(U)	 \$8,717 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. Continue development of virtual simulations for unmanned air vehicles (UAVs) used in validating autonomous control algorithms for mixed manned and UAV operations. Enhance simulation and analysis capabilities to project life cycle cost impacts. Develop the capability to virtually simulate mission utility of next generation aerospace vehicles for long range strike. 									
(U)	\$743	Initiate Congressional directed effort for advanced comprehensive engineering simulator.								
(U)	\$35,236	Total								
(U)	FY 2003 (\$ in Thousa	ands)								
(U)	\$5,289	Develop and assess advanced control mechanization to provide highly reliable operation for manned and u reduced size, weight, and cost. Demonstrate validation and verification techniques for complex, adaptive, Assess mirco-effector technologies for lightweight, long endurance air vehicle applications. Develop real-integrated prognostic health management system.	and autonomous control software. ime fault compensation using an							
(U)	 \$6,411 bevelop and assess novel control automation techniques and algorithms to enable the safe and interoperable application of unmanned vehicle systems. Concepts will also provide mission responsiveness and adaptability for improved operational effectiveness of manned and unmanned systems as well as mixed air vehicle operations. Conduct feasibility assessments of automated refueling systems concept. Develop reliability and performance analysis of self-or enable of multi-unmanned vehicle performance and self-or enable of multi-unmanned vehicle performance analysis of self-or enable									
(U)	\$3,658	 \$3,658 \$3,658 Bevelop improved flight control design methods and criteria that provide air combat advantage by increasing performance and decreasing vulnerability and cost. Complete development of adaptive guidance and control architectures for high-speed vehicles. Develop cooperative 								
Р	Project 2403	Page 8 of 14 Pages	Exhibit R-2A (PE 0602201F)							

	RDT&E	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								
BUD0 02 ·	GET ACTIVITY - Applied Resear	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Tec	hnologies	PROJECT 2403						
(U)	A. Mission Description	on Continued								
(U)	FY 2003 (\$ in Thousa	nds) Continued								
(U)	 control theory to optimize multi-ship trajectories. \$10,227 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. Complete the development of virtual simulation for unmanned air vehicles used in validating autonomous control algorithms for mixed manned and unmanned air vehicle operations. Continue to enhance simulation and analysis capabilities through incorporation of cost models to determine the affordability of new technologies. Continue development of capability to virtually simulate future strike aircraft. 									
(U)	\$25,585	Total								
(U)	<u>B. Project Change Su</u> Not Applicable.	ummary								
(U) (U) (U) (U) (U) (U)	C. Other Program Fu Related Activities: PE 0602202F, Human PE 0602204F, Aerosp PE 0603211F, Aerosp This project has been of	Inding Summary (\$ in Thousands) Effectiveness Applied Research. ace Sensors. ace Technology Dev/Demo. coordinated through the Reliance process to harmonize efforts and eliminate duplication.								
(U)	D. Acquisition Strate Not Applicable.	gy								
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.									
F	Project 2403	Page 9 of 14 Pages	Exhibit R-:	2A (PE 0602201F)						

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE	DATE February 2002	
виро 02 -	GET ACTIVITY • Applied Resea	rch			PE NUMBER AND TITLE 0602201F Aerospace Vehicle Techno					PROJ logies 240	
	COST (\$ i	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2404	Aeromechanics an	d Integration	0	29,570	26,912	31,460	31,133	32,650	34,176	Continuing	TBD
Note (U)	 Dete: Beginning in FY 2002, selected efforts from Project 2401 have moved into Projects 2403 and 2404. A. Mission Description This project develops aerodynamic configurations of a broad range of revolutionary, affordable air vehicles. It matures and applies modeling and numerical simulation methods for fast and affordable aerodynamics prediction; and integrates and demonstrates multidisciplinary advances in airframe-propulsion, airframe-weapon, and air vehicle control integration. Technologies developed will greatly enhance warfighter capability in aircraft, missiles, and high-speed aerospace vehicles. The payoffs from these technology programs include lower vehicle costs (both production, and operations and support costs), increased payload and range capability, and improved supportability, safety, and survivability of aerospace vehicles. 										
(U) (U) (U)	<u>FY 2001 (\$ in Thous</u> \$0 \$0	ands) Effort moved to Project 2401 Total									
(U) (U)	<u>FY 2002 (\$ in Thous</u> \$11,137	ands) Develop and assess aeronauti decrease human risk. Comple of long duration unmanned ae while providing low signature surveillance missions.	cal technolo ete developn erospace veh e for increase	gies that ena nent of tools iicles. Conti ed survivabi	ble broad us and techniq nue prelimir lity. Continu	e of unmann ues for predi uary develop ue developm	ed air vehic cting and op ment of con ent of signa	les in future ptimizing aer formal inlet cure compati	missions to odynamic p designs that ble, high lift	reduce life c erformance a improve airl t wings for lo	ycle cost and and survivability flow to engines ong duration
(U)	\$3,794	Develop design tools that per current fleet. Continue devel- aircraft to enhance their warfi flight-testing	mit quicker opment of an ghting abilit	and more aff nalysis tools ty. Continue	fordable cert to accelerate to enhance	ification of a e the aerodyn computer de	erodynamic namic integr sign and and	enhanceme ation of new alysis code t	nts to extend and existin hat reduces t	the operations we apons we apons we apons we apone the need for a second s	onal life of the vith current expensive
(U)	\$10,045	Develop and assess aerospace technologies that enable ultra-high speed flight and low-cost access to orbit to permit global reach. Complete comparative analyses of aerospace vehicle configurations for next generation long range strike to project global power from CONUS bases. Explore integrated airframe concepts for high-speed aerospace vehicles. Continue investigation into techniques to generate and control plasma									
Р	roject 2404			Page	10 of 14 Pag	ges			E>	hibit R-2A	(PE 0602201F)

	RDT&E	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)									
BUDO 02 -	GET ACTIVITY - Applied Resear	Ch PE NUMBER AND TITLE Ch 0602201F Aerospace Vehicle Techno	PROJECT 2404								
(U)	A. Mission Descripti	on Continued									
(U)	FY 2002 (\$ in Thousa	FY 2002 (\$ in Thousands) Continued flow field over high-speed vehicles to significantly reduce drag. Develop computational, multidisciplinary, experimental and analytical tools to simulate and control the flow fields around advanced concepts for ultra-high speed aerospace vehicles in extreme flight environments. Continue development of complex configurations that mitigate the extreme thermal environment under which high speed aerospace vehicles operate. Develop techniques to carry and deploy weapons from high speed aerospace vehicles.									
(U)	\$4,594	operate. Develop techniques to carry and deploy weapons from high speed aerospace vehicles. Develop and evaluate critical aeronautical technologies that enable directed energy weapons to be carried on future air vehicles to improve combat effectiveness. Complete analyses of integration of directed energy weapons on the total air vehicle system identifying impacts to the flight control system, secondary power subsystem, and aerodynamic configuration. Complete development of tools that establish the military impact of directed energy weapons when installed on viable air platforms on future engagements. Develop aircraft techniques to enhance energy beam transmission through the complex, turbulent aerodynamic environment surrounding aircraft enabling the use of directed energy weapons from high-speed, maneuvering aircraft.									
(U)	\$29,570	Total									
(U)	<u>FY 2003 (\$ in Thousa</u>	<u>unds)</u>									
(U)	\$8,768	decrease human risk. Continue preliminary development of conformal inlet designs that improve airflow to signature for increased survivability. Continue development of signature compatible, high lift wings for long	engines while providing low duration surveillance missions.								
(U)	\$4,087	Develop design tools that permit quicker and more affordable certification of aerodynamic enhancements to current fleet. Continue development of analysis tools to accelerate the aerodynamic integration of new and e aircraft to enhance their warfighting ability.	extend the operational life of the existing weapons with the current								
(U)	\$12,363	Develop and assess aerospace technologies that enable high-speed flight to permit global reach. Develop ex and control plasma flows. Develop analytic methods for modeling the plasma flow field over high-speed vel Continue development of complex configurations that mitigate the extreme thermal environment under whic operate. Continue development of techniques to carry and deploy weapons from aerospace vehicles operatin temperatures.	perimental capability to generate hicles to significantly reduce drag. h high-speed aerospace vehicles ag at high speeds and high								
(U)	\$1,694	Develop and evaluate critical aeronautical technologies that enable directed energy weapons to be carried on combat effectiveness. Continue development of aircraft techniques to enhance energy beam transmission the aerodynamic environment surrounding aircraft enabling the use of directed energy weapons from high-speed	future air vehicles to improve rough the complex, turbulent l, maneuvering aircraft.								
Р	roject 2404	Page 11 of 14 Pages	Exhibit R-2A (PE 0602201F)								

	RDT&E BUDGET ITEM JUSTIFICATION S	HEET (R-2A Exhibit)	DATE February 2002
budo 02 -	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Techno	PROJECT 2404
 (U) (U) (U) (U) (U) (U) (U) (U) (U) 	A. Mission Description Continued FY 2003 (\$ in Thousands) Continued \$26,912 Total B. Project Change Summary Not Applicable. C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0603211F, Aerospace Technology Dev/Demo. This project has been coordinated through the Policing and project to harmonical	efforts and aliminate duplication	
(U) (U) (U)	 D. Acquisition Strategy Not Applicable. E. Schedule Profile Not Applicable. 	enons and emminate duplication.	
Р	Project 2404 Page 1	2 of 14 Pages	Exhibit R-2A (PE 0602201F)
		80	

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) February 2002										
BUDO 02 -	BET ACTIVITY Applied Resear	ch			PE NUMBE 060220	r and title	space Ve	hicle Teo	chnologi	PROJI	
	COST (\$ in Thousands) FY 2001 FY 2002 Actual Estimate			FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost	
4397	Air Base Technolog	ЗУ	4,050	1,188	0	0	0	0	0	Continuing	TBD
In FY	2002, Project 4397, e	efforts transferred to PE 060210	2F, Project	4915.							
(U)	U) <u>A. Mission Description</u> This project develops air base technologies for fixed and bare base operations, including airfield pavements, energy systems, air base survivability, air base recovery, protective shelter systems, airfield fire protection, and crash rescue. Payoffs include air base support operations that are affordable, easily transportable, and with increased survivability of personnel and facilities.										
(U) (U)	 <u>FY 2001 (\$ in Thousands</u>) \$526 Developed aircraft and air base fire fighting technologies to improve fire fighting rescue. Tested new fire fighting agents that are non-corrosive and are not harmful to fire fighting personnel. Continued testing of advanced autonomous technologies for use in flightline fire fighting trucks 										
(U)	\$536	Developed utilities, automatic survivability for agile combat	on, and wast	e manageme egan evaluat	ent technologion of new g	gies that red round powe	uce airlift re r generation	quirements a concepts that	and improve at are highly	air base ope	rations and l lightweight.
(U)	\$88	Evaluated air transportable pr Aerospace Expeditionary For- flightline personnel.	otective she	lter technolo s. Continue	gies that are d technology	lightweight demonstrat	, structurally ion program	strong, and for lightwei	are affordab ght air infla	le and suitat table shelters	ble for s for aircraft and
(U) (U)	\$2,900 \$4,050	Initiated Congressionally dire Total	cted effort in	n weapon sy	stems logisti	cs, deployed	l base syster	ns technolog	y, and force	protection.	
(U) (U) (U)	<u>FY 2002 (\$ in Thouse</u> \$1,188 \$1,188	ands) Continue Congressionally dir Total	ected effort	for weapon	systems logi	stics, deploy	yed base sys	tems technol	ogy, and for	ce protection	1.
(U) (U) (U)	<u>FY 2003 (\$ in Thous</u> \$0 \$0	ands) No Activity Total									
(U)	B. Project Change S Not Applicable.	ummary									
P	roject 4397			Page	13 of 14 Pag	ges			Ex	hibit R-2A (PE 0602201F)

	RDT&E BUDGET ITEM JUSTIFICATION S	DATE February 2002		
BUDGE 02 - /	T ACTIVITY Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Techno	PROJECT	
(U) <u>(</u> (U) F (U) F (U) F (U) F (U) T	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0603211F, Aerospace Structures. PE 0603231F, Crew Systems and Personnel Protection Technology. This project has been coordinated through the Reliance process to harmonize	efforts and eliminate duplication.		
(U) <u>I</u> N	D. Acquisition Strategy Not Applicable.			
(U) <u>E</u> (U) N	E. Schedule Profile Not Applicable.			
Pro	pject 4397 Page	14 of 14 Pages	Exhibit R-2A (PE 0602201F)	
	UNC	82 LASSIFIED		

PE TITLE: Human Effectiveness Applied Research

	RDT&E BUDGET ITEM J	USTIFIC	CATION	SHEET	(R-2 E)	chibit)		DATE	DATE February 2002	
BUDGE7 02 - A	r activity		PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research)	
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	65,810	70,155	66,000	75,500	78,337	80,164	82,068	Continuing	TBD
1123	Warfighter Training	11,561	14,528	11,606	13,672	13,988	14,832	15,475	Continuing	TBD
1710	Deployment and Sustainment	6,471	8,016	7,735	8,495	8,418	9,703	9,581	Continuing	TBD
7184	Crew System Interface & Biodynamics	36,494	33,673	30,323	37,189	40,114	41,142	42,092	Continuing	TBD
7757	Bioeffects and Protection	11,284	13,938	16,336	16,144	15,817	14,487	14,920	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	Continuing	твр

Note: In FY 2003, the protection program at Brooks AFB moves 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 will be transferred to PE 0602500F in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) <u>A. Mission Description</u>

This program establishes technical feasibility and develops the technology base 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 increase the performance 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 2002, Congress added \$1.7 million for Rapid Detection of Biological Weapons of Mass Destruction and \$1.1 million for Fatigue Countermeasures Research.

Page 1 of 21 Pages	Exhibit R-2 (PE 0602202F)

	RDT&E BUDGET ITEM JUSTIF	DATE Febru	DATE February 2002						
BUD0 02 -	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602202F Human E	PE NUMBER AND TITLE 0602202F Human Effectiveness Applie						
(U)	<u>B. Budget Activity Justification</u> This program is in Budget Activity 2, Applied Research, since revolutionary technologies.	e it develops and determines the technical fea	sibility and military	v utility of evolutionary	⁷ and				
(U)	C. Program Change Summary (\$ in Thousands)								
(U) (U) (U)	Previous President's Budget Appropriated Value Adjustments to Appropriated Value	<u>FY 2001</u> 66,404 67,019	<u>FY 2002</u> 69,080 70,480	<u>FY 2003</u> 63,945	<u>Total Cost</u>				
	 a. Congressional/General Reductions b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram 	-1,590 996	-325						
(U) (U)	e. Rescissions Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR	-615 65,810	70,155	2,055 66,000	TBD				
(U)	Significant Program Changes: Increase in FY 2003 is due to legislative proposal in which A (previously funded by the General Fund of the Treasury).	F pays the Government share of health care a	nd life insurance pr	remiums for future civi	lian retirees				
		Page 2 of 21 Pages		Exhibit R-2	2 (PE 0602202F)				

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2								DATE	DATE February 2002		
BUD	GET ACTIVITY				PE NUMBER AND TITLE					PROJECT		
02 ·	- Applied Resea	rch			060220	2F Huma	an Effect	iveness	Applied I	Research	1123	
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost	
1123	Warfighter Training]	11,561	14,528	11,606	13,672	13,988	14,832	15,475	Continuing	TBD	
(U)) <u>A. Mission Description</u> This project develops and evaluates new methods and technologies in support of Air Force training and education requirements. The efforts focus in the areas of aircrew training; technical training; logistics training; mission rehearsal; training in support of complex decision making; space operations training; information warfare training; and warfare readiness training. It investigates the spectrum of new and advanced training and education technologies to design and implement training, and to evaluate training effectiveness. It develops and evaluates desktop tutors, courseware development tools and technologies, assessment methodologies, and simulation-based systems to determine how to achieve maximum learning effectiveness for specific needs at minimum cost. Technologies developed in this project will increase operational readiness by providing more effective methods and approaches to train and assess personnel. This project will contribute to a more highly trained and flexible cadre of personnel at a reduced cost.											
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$5,790	ands) Researched new computer rep integrated Distributed Mission by simulator visual systems c a DMT networking standard t and data manipulation to prov	presentation n Training (ontribute to to be employ vide real-tim	technologies DMT) enviro the effective yed by the er	s and percep conment. Con- eness of the contine DoD mo- contine DoD mo- contine multi-sense	tual issues conducted expendiced expendiced expendiced expendiced expendiced expendiced expension of the source of	onfronting the eriments to c ery. Comple simulation c	ne developm letermine th eted feasibil ommunity.	ent of new v e extent to w ity study and Investigated	visual system which various l began the e new comput	s to enhance the cues provided stablishment of er architectures	
(U) (U)	\$5,002 \$769	and data manipulation to provide real-time modeling of multi-sensor imagery. \$5,002 Developed tools and strategies for identifying and improving combat mission training and rehearsal and for distributing training and performance support to operational forces. Began feasibility study to embed and evaluate instructional principles in DMT simulations. Began feasibility study of integrated intelligence, surveillance, and reconnaissance data utility for aircrew mission planning, mission operations, and evaluation. Conducted knowledge engineering for ground-based satellite controller training and developed recommendations and a satellite control station exemplar for space-system operator training and performance support, and continued studies to validate integrated command and control aerospace operations centers with the DMT environment.										
	¢11 561	environment. Developed and control information systems.	implemente Developed	ed tools and new training	simulation for and team dy	or training an ynamic proto	nd assessment pools to oper	nt of perform ational users	nance in two S.	separate con	nmand and	
(U) F	Project 1123	10181		Page	3 of 21 Pag	es			E>	hibit R-2A (PE 0602202F)	

	RDT&E	DATE February 2002			
BUDG 02 -	GET ACTIVITY • Applied Resear	PROJECT ied Research 1123			
(U)	A. Mission Description	on Continued			
(U)	FY 2002 (\$ in Thousa	nds)			
(U)	\$5,006	Research new computer representation technologies and perceptual issu integrated Distributed Mission Training (DMT) environment. Explore different levels of security classification. Develop behavioral models to Explore PC-based, high-resolution, real-time image generator and ultra	tes confronting the development of no federation connectivity options for tra- o simulate the threat operators in the high resolution laser projector conce	w visual systems to enhance the aining systems operating at command and control chain. pt for DMT simulators.	
(U) (U)	\$6,536 \$2,986	Develop tools and strategies for identifying and improving combat miss performance support methods and technology exemplars to operational better training guidelines when warfighters train in DMT environments essential competencies for air superiority and global attack, and begin of warfare, information operations, and command and control. Develop a operational mission training centers, and within large-scale exercises at assessments of enhanced instructor operator station tools to embed inst assessment of operational deployment impacts on retention and decay of curricula for refresher training in pre- and post-deployment application Develop training technologies in command and control centers that sup operations through the development of training principles, guidelines, a support with automated remediation leading to a reduction in training of control systems into the DMT environment. Develop embedded training	sion training, rehearsal, and operation forces. Research will produce the er . Complete development of methods extending methods to new domains of nd validate curriculum for Air Superi command and control simulation fac ructional principles in DMT simulation of mission essential competencies and s at mission training centers. port theatre air operations centers. To nd criteria. Develop tools that will p osts with no reduction in training effec- er tools and simulations for command	s for distributing training and ppirical and analytical basis for to identify and validate mission space operations, information prity DMT implementation at ilities. Conduct usability ons, and complete a 'first look' potential contributions of specific echnologies will enhance aerospace covide real-time performance ctiveness. Integrate command and and control information systems	e 1
(U)	\$14,528	Total	is tools and simulations for command	and control mornation systems.	
(U)	FY 2003 (\$ in Thousa	nds)			
(U)	\$2,838	Research perceptual issues confronting the development of new visual visual cues necessary for realistic aircrew training and mission rehears technical performance of advanced ultra-high resolution image generat technologies. Determine feasibility of these technology developments	systems to enhance the integrated DM I, allowing Air Force warfighters to t on, ultra-high resolution projector an for the next generation DMT simulate	IT environment. Identifies the rain as they intend to fight. Assess d collimating display screen or.	\$
(U)	\$2,291	Research new computer representation technologies for the synthetic en- to enhance the integrated DMT environment. Research includes represe behavior of computer generated forces, threats, and larger wargaming re-	nvironment used in simulation-based entation of the visual, electronic, and nodels. Improve rate of learning by c	raining within a distributed mode sensor world, the weather, the eveloping pilot performance	
Р	roject 1123	Page 4 of 21 Pages		Exhibit R-2A (PE 0602202F))

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002					
вира 02 -	BET ACTIVITY • Applied Resear	PE NUMBER AND TITLE Ch 0602202F Human Effectiveness App	PROJECT lied Research 1123					
(U)	A. Mission Descripti	on Continued						
(U)	FY 2003 (\$ in Thousands) Continued diagnostics for end game tactical engagements for use in mission debrief. Determine feasibility of using large constructive wargaming model as a manager of all participating entities in distributed combat exercises. Assess existing high fidelity weather models as weather servers for all players in a distributed training exercise. Analyze methods for eliminating undesirable artifacts from the satellite source data used to build visualization tools and databases							
(U)	\$3,038 Develop tools and strategies for identifying and improving combat mission training, rehearsal, and operations for distributing training and performance support methods and technology exemplars to operational forces. Research provides the Combat Air Forces with the empirical data and guidelines for improving the quality and effectiveness of both Distributed Mission Training (DMT) and live flight training environments. Complete validation of tools to facilitate continuous learning for critical air combat skills and link these tools to skills in domains such as intelligence, surveillance, and reconnaissance and information operations. Complete operational validation studies of metrics that identify and prioritize mission essential content that can be delivered in deployable, desktop training environments located in field settings. Identify mission essential competencies underlying air superiority and global attack skills. Begin development of DMT content and scenarios							
(U)	\$3,439	Develop training technologies in command and control centers that support theatre air operations centers. To operations through the development of training principles, guidelines, and criteria. Validate mission essentia Operations Center individuals and teams. Determine feasibility of using enhanced performance assessment training exercises.	echnologies will enhance aerospace al competencies for selected Air tools in command and control	e				
(U)	\$11,606	Total						
(U)	B. Project Change S Not Applicable.	ummary						
(U) (U) (U) (U) (U) (U) (U)	 <u>C. Other Program Funding Summary (\$ in Thousands)</u> Related Activities: PE 0602233N, Human Systems Technology. PE 0602716A, Human Factors Engineering Technology. PE 0602785A, Personnel Performance and Training Technologies. PE 0603227F, Personnel, Training, and Simulation Technology. PE 0603231F, Crew Systems and Personnel Protection Technology. 							
P	roject 1123	Page 5 of 21 Pages	Exhibit R-2A (PE 0602202F)	.)				
		87						

	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 2002	
вир 02	GET ACTIVITY - Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness App	PROJECT lied Research 1123
(U) (U) (U)	<u>C. Other Program Funding Summary (\$ in Thousands)</u> PE 0604227F, Distributed Mission Training (DMT). This project has been coordinated through the Reliance process to harmonize	e efforts and eliminate duplication.	
(U)	D. Acquisition Strategy Not Applicable.		
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.		
F	Project 1123 Page	e 6 of 21 Pages	Exhibit R-2A (PE 0602202F)
	UNC	⁸⁸ CLASSIFIED	

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) PATE February 2002								ry 2002		
BUDO 02 -	BUDGET ACTIVITY PE NUMBER AND TITLE PROJE 02 - Applied Research 0602202F Human Effectiveness Applied Research 1710										PROJECT 1710
	COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
1710	Deployment and S	Sustainment	6,471	8,016	7,735	8,495	8,418	9,703	9,581	Continuing	TBD
(U)	U) <u>A. Mission Description</u> This project develops technologies to support the enhancement of the deployment and sustainment capabilities critical to Agile Combat Support and Air Expeditionary Force (AEF) operations. The research focuses on technologies with the potential to reduce the time required for units to plan, pack up, and deploy, and to reduce airlift requirements while enhancing deployed capability. It investigates and evaluates technologies to enhance the sustainment of deployed forces in contingency operations; and to improve logistics support for both combat and peacetime operations. It develops toxicological tools and technology to minimize the risks and mission impact to DoD personnel from exposure to hazardous chemicals, while also reducing weapon systems life cycle cost.										
(U) (U)	 <u>FY 2001 (\$ in Thousands</u>) \$1,835 Developed logistics sustainment technology options and performed feasibility studies to support large-scale advanced technology development programs. These technologies lead to more supportable weapon systems at reduced logistics support costs. Developed software to transform procedural maintenance instructions into graphic-oriented computer simulations for validation analysis. Developed neural network concepts 										
(U)	\$1,791	Developed logistics readiness programs. These technologie retrofit aircraft with automate component failures. Explored	technology s lead to mo d sensors to t technology	options and re efficient u collect and to automati	performed f utilization of record system cally collect	easibility stu logistics res n performan asset status	adies to supp sources for A ace data for e information	ort large-sca EF operatio nhanced cap to provide r	ile advanced ns. Investig pability to di eal-time info	l technology ated various agnose and p ormation for	development technologies to oredict management of
(U)	\$2,845	Demonstrated and applied pre exposure to operational comp fuel oxidizer. Applied predic	edictive hum ounds and n tive tools to	an health as naterials for assist fuels	sessment mo force protect developers it	odels to accu tion. Establi rapidly scr	rately charac shed a healt eening vario	cterize the h h-based expo us additives	uman health osure standa for toxicity.	risks associa rd for an Air	ted with Force missile
(U)	\$6,471	Total			pois ii						
P	roject 1710			Page	7 of 21 Pag	es			Ex	hibit R-2A (PE 0602202F)

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February	2002				
BUDG 02 -	BET ACTIVITY Applied Resear	ied Research	PROJECT 1710					
(U)	A. Mission Descripti	on Continued						
(U)	FY 2002 (\$ in Thousa	<u>nds)</u>						
(U)	 \$1,989 Develop logistics sustainment technology options and perform feasibility studies to support large-scale advanced technology development programs. These technologies will lead to more supportable weapon systems at reduced logistics support costs. Develop software tools to automatically generate maintenance procedures from weapon system design descriptions. Define functional requirements for theater sustainment and distribution decision support tools. Develop artificial intelligence software architectures for improved depot repair forecasting and more timely efficient home-based support for the warfighter. Develop advanced computer models for representing human cognition in simulations. 							
(U)	 \$2,126 Develop logistics readiness technology options and perform feasibility studies to support large-scale advanced technology development programs. These technologies will lead to more efficient utilization of logistics resources for Air Expeditionary Force (AEF) operations. Conduct feasibility studies and devise preliminary plans for presenting various types of information to maintenance and logistics personnel, such as aircraft status, supply status, and diagnostics data. The focus will be on display techniques for the support of the logistics commanders and their staff. Investigate the feasibility of developing a distributed logistics training campbility to support the logistics community. 							
(U)	\$3,901	Demonstrate and apply predictive human health assessment models to accurately characterize the human health operational compounds and materials for force protection. Demonstrate and apply methods to quantify sk solvents used in flight operations and maintenance processes. Develop a biologically-based model for validate Force missile fuel oxidizer. Begin to develop innovative biotechnology techniques.	alth risks associated was in toxicity risks from ation of exposure stand	ith exposure fuels and dards for Air				
(U)	\$8,016	Total						
(U)	FY 2003 (\$ in Thousa	<u>nds</u>)						
(U)	\$1,953	Develop logistics sustainment technology options and perform feasibility studies to support large-scale adva programs. These technologies will lead to more supportable weapon systems at reduced logistics support co algorithms and interface requirements for virtual validation of maintenance technical order data. Develop ar components to realistically model team decision making in synthetic environments.	nced technology devel sts. Develop transforn tificial intelligence so	lopment nation ftware				
(U)	\$1,837	Develop logistics readiness technology options and perform feasibility studies to support large-scale advance programs. These technologies will lead to more efficient utilization of logistics resources for AEF operation studies and devise preliminary plans for the presentation of various types of information to maintenance and the information presented and the platforms to be used. Begin work to define the technology requirements a support a completely automated maintenance environment.	ed technology develop s. Continue to conduc logistics personnel to nd component researc	ment t feasibility include both h areas to				
Р	roject 1710	Page 8 of 21 Pages	Exhibit R-2A (PE	0602202F)				

	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 2002	
BUD0 02 ·	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Appl	PROJECT ied Research 1710
(U) (U) (U)	A. Mission Description Continued FY 2003 (\$ in Thousands) Continued \$3,945 Develop, demonstrate, and apply predictive assessm operational compounds and materials for force prote contact with fuels, solvents, and other hazardous cha genomics and proteomics to identify exposure of an biologically based toxicity models	nent models to accurately characterize the toxicological ri ection. Establish biologically based approach for predicti emicals used in the DoD. Develop innovative biotechnol imals to toxic substances and begin to employ that inform	sks associated with exposure to ng skin irritation from dermal ogy techniques employing nation to develop human
(U) (U)	\$7,735 Total B. Project Change Summary Not Applicable.		
(U) (U) (U) (U) (U) (U) (U)	 C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602233N, Human Systems Technology. PE 0602716A, Human Factors Engineering Technology. PE 0603106F, Logistics Systems Technology. PE 0603231F, Crew Systems and Personnel Protection Technology. This project has been coordinated through the Reliance process to harmonized throug	ze efforts and eliminate duplication.	
(U)	D. Acquisition Strategy Not Applicable.		
(U) (U)	E. Schedule Profile Not Applicable.		
F	Project 1710 Pag	ge 9 of 21 Pages	Exhibit R-2A (PE 0602202F)

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)							DATE	DATE February 2002		
вира 02 -	BUDGET ACTIVITY 02 - Applied Research					r and title 2F Huma	an Effect	iveness /	Applied F	Research	PROJECT 7184
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
7184	Crew System Interf	face & Biodynamics	36,494	33,673	30,323	37,189	40,114	41,142	42,092	Continuing	TBD
Note In FY uniqu	In FY 2003, the prot 2003, space unique ta e activities.	ection program at Brooks AFB asks in Project 7184 will be trai	moves from nsferred to P	Project 718 E 0602500F	4 to Project in conjunct	7757 to alignion with the	n resources v Space Com	with the Air nission reco	Force Resea mmendation	rch Laborato to consolida	bry organization. ate all space
(U)	J) <u>A. Mission Description</u> This project develops the technology required to improve human performance, biodynamics response, and survivability in operational environments. This is accomplished by defining the physical and cognitive parameters, capabilities, and limits of systems operators; determining human responses to operational stresses such as noise, impact, vibration, sustained acceleration, spatial disorientation, and workload; and optimizing the human-machine interface. The project produces human-centered design criteria, guidelines, and automated design tools for the development of effective crew-systems interface. It develops and assesses technologies for information display, human-centered information operations, team communications, and modeling and simulation. It conducts experiments and evaluations of control interfaces, crew station layout and functional integration, aircrew information processing, crash protection, and emergency escape. Note: In FY 2002,										
(U)	FY 2001 (\$ in Thous	ands)									
(U)	 \$4,053 Developed interface technologies for crew station and equipment accommodation, multi-sensory adaptive controls and displays, and performance metrics. Completed multi-sensory control station and operator workload classification algorithm and incorporated into laboratory demonstration of unmanned aerial vehicle control. Validated cockpit accommodation maps of inventory aircraft. Began to develop an intelligent, on-line physical accommodation information system to optimize equipment fit, and include Dutch anthropometric data from multi-sensory. 										
(U)	\$3,175	3,175 Developed cognitive information technology and human speech processing and control solutions for time-critical command and control to achieve common understanding at all echelons of information operations and to improve decision-making. Developed and demonstrated new user-computer interface for all-source intelligence analysts for faster and more accurate decision-making. Continued research on speech signal									
(U)	\$4,236	Developed concepts for integ quantify operational benefit fi unmanned vehicles, demonstr	rating human rom new inter rating multi-	n computer i erface techno vehicle per r	nterface tech plogies. Con nission oper	nnologies, m npleted a fea ation. Deve	odels of hur asibility eval loped integr	nan behavio luation of an ated flight pa	r, and real-ti integrated c ath and syntl	me simulatio ontrol interfa netic terrain	ons to affordably ace for concept for
Р	roject 7184			Page	10 of 21 Pag	ges			Ex	hibit R-2A	(PE 0602202F)

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002
BUD0 02 -	GET ACTIVITY - Applied Resear	PE NUMBER AND TITLE Ch 0602202F Human Effectiveness A	PROJECT pplied Research 7184
(U)	A. Mission Descripti	on Continued	
(U)	FY 2001 (\$ in Thousa	nds) Continued	
(U)	\$4,227	primary flight reference on heads-up displays. Developed visual display interface technologies, specifically helmet-mounted displays, night vision tech developed an understanding of the effects of vision through display optics, vehicle transparencies, and s helmet-mounted display symbology specifications for strike missions. Conducted study to determine the transmissivity and reflectivity on visual target detection	nnologies, large flat panel displays, and ynthetic vision. Established e influence of helmet visor
(U)	\$2,533	Developed advanced audio displays including three-dimensional (3-D) audio, active noise reduction, ar effects of noise and enhance performance in the operational environment. Completed a feasibility dem- headset with noise reduction and CD quality digital audio. Developed acoustic processing algorithms a interface to add a new capability for remote threat detection in perimeter defense. Developed prelimina for improving situational awareness using 3-D audio displays.	d related technologies that mitigate onstration of an integrated 3-D audio nd an intuitive human-centered ry auditory symbology design criteria
(U)	\$3,337	Developed human injury and protective systems design criteria for use against hazards encountered in environments. Research develops technologies to ensure full aircrew population safety during all phase including emergency escape and crashes. Incorporated tolerance and injury criteria into the developme injury assessment. Continued study to define multi-axis head and neck response during impact. Define to improve injury prediction in dynamic environments and to optimize restraint concepts. Refined biod helmet-mounted devices to optimize safe helmet-mounted system concepts.	mergency escape or crash s of aircraft and vehicle operations at of mathematical models to be used for d male and female tolerance standards ynamic performance assessment of
(U)	\$6,213	Developed aviation safety enhancing technologies to alleviate warfighter fatigue, counter spatial disorie under high gravitational forces. Results will extend and enhance cognitive performance during Air Exp long-range global attack missions, reduce mishaps due to spatial disorientation, and minimize adverse i combat effectiveness. Expanded the capabilities of the fatigue avoidance scheduling tool to predict the countermeasures on fatigue, and initiated efforts to extend the management of fatigue so as to apply its component of Information Warfare strategy. Evaluated effectiveness of candidate techniques to impro- aircrew wearing night vision goggles. Conducted evaluation of feasibility of employing innovative pre- advanced materials to improve pilot performance by reducing the bulk, weight, and thermal burden of e ensembles.	ntation, and improve pilot performance editionary Force deployments and npacts of acceleration stresses on effects of pharmaceutical mpact on decision making as a ve spatial orientation capabilities in sure application techniques and xisting acceleration protection
(U)	\$3,835	Progressed solid state electrolyte oxygen generation technologies for aircraft and ground-based oxygen reliability and reduce aircraft dependence on liquid oxygen infrastructure. Continued research to impro-	generating systems to improve ve oxygen production efficiency, lower
P	Project 7184	Page 11 of 21 Pages	Exhibit R-2A (PE 0602202F)
		93	

	RDT&E	DATE February 2002						
BUDO	GET ACTIVITY	PROJECT						
02 -	- Applieu Resear							
(U)	A. Mission Description	on Continued						
(U)	FY 2001 (\$ in Thousa	nds) Continued power consumption, lower operating temperature, and improve thermal management concepts. Designed, fa testing of solid state electrolyte oxygen generator concepts	bricated, and conducted laboratory					
(U)	 \$3,063 Provided human systems technology support to the joint Air Force/Defense Advanced Research Projects Agency Unmanned Combat Air Vehicle program. The Unmanned Combat Air Vehicle (UCAV) program will demonstrate unmanned air vehicle technologies, including the remote operator control/display interface, that can extend the capability to effectively and affordably perform the 21st century combat missions of defense suppression and tactical attack. 							
(U)	\$1,439 Conducted international cooperative effort with Australia for Virtual Air Commanders, involving human interface technology for airborne early warning. Performed international laboratory experiment in each country using real-time simulators employing distributed interactive simulation technology. Demonstrated feasibility of an integrated multi-sensory crew station for Virtual Air Commanders tailored for early warning and control mission							
(U)	\$383	Conducted altitude protection research to maximize warfighter survivability and combat effectiveness in the Research defined life support equipment design concepts and procedures to enable safe flight operations at h quantify altitude decompression sickness risk for special operations and combat search and rescue missions i	aerospace flight environment. igh altitudes. Continued studies to in unpressurized aircraft.					
(U)	\$36,494	Total						
(U)	FY 2002 (\$ in Thousa	<u>nds</u>)						
(U)	\$4,093	Develop interface technologies for crew station and equipment accommodation, multi-sensory adaptive contr metrics. Determine the feasibility of extending real-time workload classification technology into unmanned and evaluate reduced crew operation in a multi-sensory unmanned aerial vehicle control station. Complete d accommodation and NATO three-dimensional human population as core elements for an intelligent, on-line information system to optimize equipment fit. Perform laboratory experiments using a virtual air command interface design requirements for airborne early warning and control.	rols and displays, and performance combat aerial vehicle operations, latabases for cockpit physical accommodation station to determine human					
(U)	\$5,707	Develop cognitive information technology and human speech processing and control solutions for time-critic achieve common understanding at all echelons of information operations and to improve decision-making. Of interface concepts for intelligence analysts, investigate a display interface for integrated asset management, a Air Operations Centers, and provide a laboratory demonstration of a rapid shared display for command center analysis and definition of human-machine interfaces and decision support tools for global attack. Begin deve	cal command and control to Continue to devise user-computer analyze decision-support aids for er situation awareness. Begin elopment of operator interface					
Р	Project 7184	Page 12 of 21 Pages	Exhibit R-2A (PE 0602202F)					
		04						

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE	February	2002			
BUDO		Applied D	Dooosrah	PROJECT				
02 -	Applied Resear	ch 0602202F Human Effectiveness	Аррпеа к	kesearch	/184			
(U)	A. Mission Descripti	on Continued						
(U)	FY 2002 (\$ in Thousa	unds) Continued	_					
(U)	 concepts and descriptive performance metrics in support of the Targets Under Trees program. Continue research on speech signal processing and speech-based countermeasures for information operations, including a concept demonstration of an intelligent voice jammer. \$3,788 Develop concepts for integrating human computer interface technologies, models of human behavior, and real-time simulations to affordably quantify operational benefit from new interface technologies. Produce design guidelines for an integrated control interface for unmanned vehicles. Continue to develop operator-vehicle interface concepts for exploiting real-time, off-board data and demonstrate payoffs for mobility/(pecial operations missions in laboratory simulations. Complete a face/billity avaluation for validating a digital model of human 							
(U)	\$4,484	decision-making behavior. Develop visual display interface technologies, specifically helmet-mounted displays, night vision tec develop an understanding of the effects of vision through display optics, vehicle transparencies, and replacing the heads-up display with a helmet-mounted display, establish color contrast guidelines, an symbology for attitude displays. Establish design guides for windscreens and night vision displays.	nologies, larg ynthetic visior I develop fram Determine reso	ge flat panel disp n. Conduct stud nes of reference olution and brig	plays, and ly on and htness			
(U)	\$2,939	Develop advanced audio displays including three-dimensional (3-D) audio, active noise reduction, ar of noise and enhance performance in the operational environment. Plan system integration and labor acoustic remote threat detection in perimeter defense. Conduct research on (50 dB) hearing protection in high performance aircraft. Develop human performance standards for helmet-mounted cueing systems.	d related techn tory test as ini technologies	nologies that min attial implementa s for improved p	tigate effects ation for an performance			
(U)	\$996	Develop integrated human-centered information warfare technologies to assess and predict human perconditions and to influence an adversary's decision-making function. This research will provide informanagement tools and the means to evaluate the effectiveness of information warfare strategies on the efforts will model effects of cross-cultural communications on human decision-making behavior. Au applied to develop perception management tools for offensive counter-information applications.	formance und mation warrio human target ditory and visu	der information ors with human p et set. Cognitive ual technologies	warfare perception modeling s will be			
(U)	\$3,288	Develop human injury and protective systems design criteria for use against hazards encountered in or Research will develop technologies to ensure full aircrew population safety during all phases of aircr crashes, emergency escape, and parachute opening shock. Begin developing injury assessment toolb assessment on personal protection and life support equipment, and seat and cockpit systems. Develo from ejection seat recorder. Conduct laboratory studies on adaptable restraint system technologies for aircraft.	rash environm ft and vehicle ox to be used in analysis technor application a	nents and emerge operations inclu- in conducting in aniques for evalu- across Air Force	ency escape. uding jury risk tating data airlift			
Р	roject 7184	Page 13 of 21 Pages	Ext	hibit R-2A (PE	0602202F)			
		95						

	RDT&E	DATE February 2002	
виро 02 -	GET ACTIVITY • Applied Resear	PE NUMBER AND TITLE Ch 0602202F Human Effectiveness Appl	PROJECT ied Research 7184
(U)	A. Mission Descripti	ion Continued	
(U) (U)	<u>FY 2002 (\$ in Thousa</u> \$8,378	ands) Continued Develop aviation safety technologies to alleviate/mitigate warfighter fatigue, counter spatial disorientation, a high altitude and under high gravitational forces. Results will extend and enhance cognitive performance du deployments and long-range global attack missions. This research will also reduce mishaps due to spatial dis impacts of acceleration stresses on combat effectiveness. Extend fatigue management technologies to provid mission planners with the capability to evaluate effects of alternative schedules on crew performance and mis fatigue countermeasures research to evaluate the operational efficacy of emerging alertness enhancing medic spatial disorientation countermeasures research efforts to improve primary flight displays and reduce pilot we more intuitive symbology and improve pilot training through development of ground-based and flight-based practices. Focus acceleration protection research efforts on defining physiological and performance effects of assessing the effects of pharmaceutical fatigue countermeasures on flight safety and pilot effectiveness in the cockpit of modern fighter aircraft.	nd improve pilot performance at ring Air Expeditionary Force orientation, and minimize adverse le operational commanders and ssion effectiveness. Conduct vations such as modafinil. Conduct orkload through development of spatial orientation training of thrust-vectored flight and e high performance/high demand
(U)	\$33,673	Total	
(U) (U)	<u>FY 2003 (\$ in Thousa</u> \$4,147	ands) Develop interface technologies for crew station and equipment accommodation, multi-sensory adaptive contr metrics. Evaluate methods for employing real-time measurement of crew workload, as it changes with missi and decision support in multi-ship unmanned air vehicle missions. Demonstrate proof-of-concept for intellig accommodation to optimize equipment fit, enabling future crew stations and equipment to adapt to human va experiments exploring crew interface concepts for airborne command and control, demonstrate an advanced warning, and explore interface technologies for supervision of multiple autonomous unmanned air vehicles.	rols and displays, and performance on events, to adjust automation gent, on-line physical triability. Complete laboratory crew station for airborne early
(U) (U)	\$4,631 \$4,208	Develop cognitive information technology and human speech processing and control solutions for time-critic achieve common understanding at all echelons of information operations and to improve decision-making. He for a cognitive interface and knowledge repository to support information operations in the future aerospace support the Targets Under Trees program by improving the ability to fuse imagery and signals intelligence. In processing and speech-based countermeasures for information operations and commence a multi-year program stressed-speech identification capability including foreign language speech recognition. Develop concepts for integrating human computer interface technologies, models of human behavior, and real	al command and control to Explore conceptual design options operations center. Continue to Continue research on speech signal im to demonstrate a robust al-time simulations to affordably
Р	roject 7184	Page 14 of 21 Pages	Exhibit R-2A (PE 0602202F)

	RDT&E	BUDGET ITEM JUSTIFICATION S	SHEET (R-2A Exhibit)	DATE February 2002					
BUDO		PROJECT							
02 -	Applied Resear	cn	0602202F Human Effectiveness Appl	led Research 7184					
(U)	A. Mission Descripti	on Continued							
(U)	FY 2003 (\$ in Thousands) Continued quantify operational benefits from new interface technologies. Continue simulation software for an integrated, unmanned air vehicle crew station. Continue to develop operator-vehicle interface concepts for mobility using real-time, off-board data to assure tactical information dominance with minimum crew size. Explore control-display technology options for unmanned reconnaissance vehicles, and begin to explore human performance requirements and fusion of on-board and off-board sensor data with imagery in a single display. Aggregate models of								
(U)	\$5,030	Develop visual display interface technologies, specific develop an understanding of the effects of vision throu to calibrate color displays in the field environment to p quality. Begin to quantify the effects of binocular disp windscreens. Determine feasibility and technical appro- standards for large flat-panel displays.	ally helmet-mounted displays, night vision technologi- gh display optics, vehicle transparencies, and syntheti- ermit evaluating operational system displays, and dev arity and distortion, which negatively affect vision thr pach for exploiting color night vision in helmet-mount	es, large flat panel displays, and c vision. Demonstrate the ability elop an approach to model image ough helmet transparencies and red displays. Develop testing					
(U)	\$3,293	Develop advanced audio displays including three-dime of noise and enhance performance in the operational er and speed acoustic remote threat detection in perimeter performance (50 dB) hearing protection system. Begin the sound field, usable for environmental analysis and	ensional (3-D) audio, active noise reduction, and relate nvironment. Demonstrate feasibility of 3-D audio for r defense. Recommend technologies, assess technolog n to develop a dynamic noise model that can be integra for developing vectored thrust tactics to minimize aco	d technologies that mitigate effects security forces to localize threats gy risk, and plan to develop a high ated with real-time visualization of ustic detection.					
(U)	\$1,143	Develop integrated human-centered information operations conditions to provide improved displays for to improve situational awareness, and to provide more provide information operations warriors with human properations strategies on the human target set. Human properations counter-information operations. Concepts of planning, and decision aids and warfighter-tailored information developed.	tions technologies to assess and predict human perform quicker, more intuitive access to information, to enha effective training procedures and fatigue management erception management tools and the means to evaluate perception management tools will be refined for poten f operation for effects-based planning, demonstrations pormation visualizations that specifically focus on infor	nance under information ince decision-making capabilities, techniques. This research will the effectiveness of information tial weaponization in offensive and of prototypes for next-generation mation operations will be					
(U)	\$5,771	Develop human injury criteria and protective system te environments. Research will develop technologies to e including high gravitational forces, crashes, emergency	echnologies for use against hazards encountered in cra- ensure full aircrew population safety during all phases y escape, extended missions, and parachute opening sh	sh and other hazardous of aircraft and vehicle operations lock. Revise injury criteria based					
Р	roject 7184	Page	5 of 21 Pages	Exhibit R-2A (PE 0602202F)					
			97						

	RDT&E BUDGET ITEM JUSTIFICATION	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								
budo 02 -	GET ACTIVITY - Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Appl	PROJECT ied Research 7184							
(U)	A. Mission Description Continued									
(U)	FY 2003 (\$ in Thousands) Continued on data from actual mishaps with ejection seat data recorder. Develop adaptable restraint system technologies, ensuring safety and expedient accommodation of diverse warfighters in Air Force transportation platforms. Thrust-vectored flight research results will improve aircrew performance in the operational environment. Research will provide cognitive performance and human information processing models that can be incorporated in war games and simulation-based acquisition models to accurately reflect the effects of physical stressors on human performance and mission effectiveness. \$2 100 Develop technologies to counter spatial disorientation and improve pilot performance. Spatial disorientation countermeasures research will									
(U) (U)	 \$2,100 \$2,100 Develop technologies to counter spatial disorientation and improve pilot performance. Spatial disorientation countermeasures research will explore the feasibility of integrating emerging technologies such as 3-D audio, tactile situation awareness suit, pathway in the sky displays, and night vision devices to improve pilots' ability to maintain spatial orientation, thus preventing occurrence of spatial disorientation, and to aid recognition and recovery from spatial disorientation if it should occur. \$30,323 									
(U)	B. Project Change Summary									
(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	 C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602201F, Aerospace Flight Dynamics. PE 0602204F, Aerospace Sensors. PE 0602500F, Multi-disciplinary Space Technology. PE 0602702F, Command, Control, and Communications. PE 0603205F, Flight Vehicle Technology. PE 0603231F, Crew Systems and Personnel Protection Technology. PE 0603245F, Flight Vehicle Technology Integration. PE 0604703F, Aeromedical Systems Development. PE 0604706F, Life Support Systems. This project has been coordinated through the Reliance process to harmoniz D. Acquisition Strategy 	e efforts and eliminate duplication.								
	Not Applicable.									
P	Project /184 Page	e 16 of 21 Pages	Exhibit R-2A (PE 0602202F)							

	DATE	DATE					
	IFICATION SHEET (R-2A EXHIBIT)	February	/ 2002				
BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT				
02 - Applied Research	0602202F Human Effectiveness A	oplied Research	7184				
(U) E. Schedule Profile							
(U) Not Applicable.							
During 7404	D 17 (21 D						
Project /184	Page 17 of 21 Pages	Exhibit R-2A (P	E 0602202F)				
	99						
UNCLASSIFIED							

	RDT&I	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
вирс 02 -	BET ACTIVITY Applied Reseat	rch			PE NUMBE 060220	R AND TITLE	an Effect	iveness	Applied I	Research	PROJECT 7757
	COST (\$ in Thousands) FY 2001 FY 2002 Estimate				FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
7757	Bioeffects and Prot	ection	11,284	13,938	16,336	16,144	15,817	14,487	14,920	Continuing	TBD
Note	e: In FY 2003, the protection program at Brooks AFB moves from Project 7184 to Project 7757 to align resources with the Air Force Research Laboratory organization. <u>A. Mission Description</u> This project predicts and mitigates the effects of exposure to radio frequency energy, high power microwaves, ultra-wide band pulsed fields, lasers, warfighter fatigue, altitude and high onset rate G-forces. The project enables the safe operational use of Air Force aerospace systems through technology development to ameliorate/counter/exploit the biological effects of aerospace stressors including directed energy. It addresses areas such as safety, risk assessment, mission planning, countermeasures, and aircrew protection. The project also assesses the bioeffects of non-lethal directed energy technologies for force protection, special operations, military operations other than war, and peacekeeping applications. Note: In FY 2002, Congress added \$1.7 million for Rapid Detection of Biological Weapons of Mass Destruction.										
(U) (U)	Mass Destruction. FY 2001 (\$ in Thousands) \$4,024 Conducted laser optical bioeffects laboratory experiments and field research, enabling exploitation of laser technology while researching countermeasures for optical hazards/threats, with and without laser eye protection. Initiated work with the United States Marine Corps Joint Non-Lethal Weapons Directorate to develop non-lethal laser use guidelines in compliance with DoD/International Policy while enhancing effectiveness. Completed the personnel biological effects model to assess combat vulnerability to emerging optical threats. Developed and demonstrated technology to produce a safe, active lasing experience into aircrew simulators, leading to development and refinement of engagement tactics, countermeasures, and training requirements. Expanded research in optical technology development for information warfare. Completed experiments with Federal Aviation Administration on safe active lasing. (*) \$5,780 Conducted radio frequency bioeffects laboratory experiments to enable safe exploitation of directed energy weapons and radar. Continued Air										
(U) (U)	\$484 \$996	millimeter effects on skin can warfare applications. Evaluated Photorefractive Ke year post-operative data. Advanced rapid diagnostic an infections.	acer and corr cratectomy a ad biological	neal eye dam s surgical mo fingerprinti	age for DoE ethod to redu ng technique	exposure g ace aircrew r es along with	uidance. Co need for glas n molecular :	ntinued way ses or conta monitoring s	ve propagation ct lenses. Co systems for t	on modeling ollected and he detection	for information analyzed second of nosocomial
Р	roject 7757			Page	18 of 21 Pag	ges			E>	hibit R-2A	(PE 0602202F)

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhib	DATE February 2002							
BUDG 02 -	BET ACTIVITY Applied Resear	ch PE NUMBER AND TITLE Ch 0602202F Human Ef	fectiveness Appl	ied Research	PROJECT 7757					
(U)	A. Mission Description	on Continued								
(U) (U)	<u>FY 2001 (\$ in Thousa</u> \$11,284	<u>nds) Continued</u> Total								
(U) (U)	FY 2002 (\$ in Thousands) \$5,581 Conduct laser optical bioeffects laboratory experiments and field research, enabling exploitation of laser technology while researching countermeasures for optical hazards/threats with and without laser eye protection. Assess bioeffects of agile laser technologies. Provide guidance for non-lethal laser illuminator employment. Demonstrate technologies for safe, active lasing in aircrew simulators, supporting improved engagement tactics, countermeasures, and laser safety training requirements.									
(U)	 improved engagement tactics, countermeasures, and laser safety training requirements. \$5,814 Conduct radio frequency bioeffects laboratory experiments to enable safe exploitation of electromagnetic energy for directed energy weapons, non-lethal weapons, communications, and radar. Evaluate cellular damage and behavioral/cognitive disruption from pulsed radio frequency emitters. Continue health and safety studies on millimeter waves. Improve technology and models for radio frequency exposure prediction, assessment, and hazard warning. 									
(U)	\$298	Conclude post-operative evaluation and issue interim recommendations on the study reduce aircrew need for glasses or contact lenses	of Photorefractive Kera	tectomy as a surgical m	nethod to					
(U)	\$545	545 Develop safety design criteria for portable Active Denial Technology in support of the Air Expeditionary Force/Agile Combat Support initiative, enabling safe exploitation of directed energy weapons. Research and resolve human safety, control, and pointing and tracking issues of directed energy. Verify the non-harmful effects of the active denial technology. Develop safety design criteria for directed energy systems								
(U) (U)	\$1,700 \$13,938	Design and develop probe kits to rapidly detect and identify biological weapons of m Total	ass destruction.							
(U)	FY 2003 (\$ in Thousa	nds)								
(U)	 \$5,108 \$5,108 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. Begin evaluation of eye protection technologies to counter the agile laser threat. Investigate the safety and effectiveness of emerging compact ultrashort laser technologies for both anti-material and non-lethal weapons applications. Explore new methods of conducting threshold damage studies to reduce reliance on in vivo experimentation. Expand research in optical technology development for information worfare and perception menagement conducting. 									
(U)	\$7,203	Conduct radio frequency bioeffects laboratory experiments to enable safe exploitatio biological effects of high power microwave and nanopulse emissions. Evaluate cellu	n of directed energy. Ex	xpand laboratory assess uency energy. Complet	ment of te updated					
Р	roject 7757	Page 19 of 21 Pages		Exhibit R-2A (PE	0602202F)					

	RDT&E	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								
вирс 02 -	GET ACTIVITY • Applied Resear	PE NUMBER AND TITLE Ch 0602202F Human Effectiveness Appl	PROJECT ied Research 7757							
(U)	A. Mission Description	on Continued								
(U)	FY 2003 (\$ in Thousands) Continued laboratory and field radio frequency radiation (RFR) Dosimetry Tools for assessment of RFR exposure dose assessments by bioenvironmental engineering and occupational health personnel. Develop radio frequency and optical radiosensitive biotechnology tools to counter the proliferation of biological weapons of mass destruction.									
(U)	\$500 Develop safety design criteria for portable active denial technology in support of the Air Expeditionary Force/Agile Combat Support initiative, enabling safe exploitation of directed energy weapons. Fabricate laboratory breadboard and complete laboratory demonstration of portable active denial technology. Begin assessments of cognitive and psychosocial effects of non-lethal applications while attending to needs of the intelligence community.									
(U)	 b) 3,525 Develop aviation safety enhancing technologies to alleviate warfighter fatigue, counter physiological effects of high altitude flight, and improve pilot performance under high, rapid-onset gravitational forces. Results will extend and enhance cognitive performance during Air Expeditionary Force deployments and long-range global attack missions, and minimize adverse impacts of altitude and acceleration stresses on combat effectiveness. Sustained operations research will continue development and validation of quantitative models describing the effects of fatigue on human performance and mission effectiveness to increase the accuracy and realism of current human behavior representations used in war games simulations, training exercises, and information warfare planning activities. 									
(U)	\$16,336	Total								
(U)	<u>B. Project Change Su</u> Not Applicable.	immary								
(U) (U) (U) (U) (U) (U)	 J. C. Other Program Funding Summary (\$ in Thousands) J. Related Activities: J. PE 0602720A, Environmental Quality Technology. J. PE 0603231F, Crew Systems and Personnel Protection Technology. J. PE 0604706F, Life Support Systems. J. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. 									
(U)	D. Acquisition Strate Not Applicable.	gy								
(U)	<u>E. Schedule Profile</u>									
Р	roject 7757	Page 20 of 21 Pages	Exhibit R-2A (PE 0602202F)							

	DATE							
		February	/ 2002					
		anlied Desserves	PROJECT					
uz - Applied Research	UOUZZUZE HUMAN ETTECTIVENESS A	oplied Research	(15)					
(U) <u>E. Schedule Profile Continued</u>								
(U) Not Applicable.								
Project 7757	Page 21 of 21 Pages	Exhibit R-2A (Pl	= 0602202F)					
	103							
UNCLASSIFIED								

THIS PAGE INTENTIONALLY LEFT BLANK

PE TITLE: Aerospace Propulsion

	RDT&E BUDGET ITEM J	USTIFIC	ATION	SHEET	(R-2 E)	(hibit)		DATE	Februa	ary 2002
BUDGE ⁻ 02 - A	r activity Applied Research			PE NUMBE 060220	R AND TITLE	space Pr	opulsion			
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	144,355	178,485	107,659	118,958	114,560	114,674	115,981	Continuing	TBD
3012	Advanced Propulsion Technology	0	21,436	3,637	14,894	12,909	12,903	12,945	Continuing	TBD
3048	Fuels and Lubrication	8,501	12,549	15,060	16,009	16,201	15,513	14,847	Continuing	TBD
3066	Turbine Engine Technology	40,168	44,864	43,630	41,359	38,146	38,025	38,874	Continuing	TBD
3145	Aerospace Power Technology	26,727	27,376	26,890	27,831	28,090	28,688	29,266	Continuing	TBD
4847	Rocket Propulsion Technology	68,959	72,260	18,442	18,865	19,214	19,545	20,049	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: In FY 2002, the Hypersonic Technology Program work performed in PE 0602203F, Project 3066; PE 0603202F, Project 688A; and PE 0603216F, Project 681B was transferred to Project 3012 in this PE in order to align projects with the Air Force Research Laboratory organization. In FY 2003, only the space unique tasks in Projects 3012 and 4847 will be transferred to PE 0602500F in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, this program anticipates receiving \$5.7 million from the Cost of War Transfer Account. These funds are not included in the FY 2003 Air Force baseline. Funding will be used for rocket propulsion technologies in support of the Technology for Sustainment of Strategic Systems program.

(U) <u>A. Mission Description</u>

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: 1) The Turbine Engine Technology project develops enabling capabilities to enhance performance and affordability of existing weapon systems. Turbine Engine Technology project efforts are part of the Integrated High Performance Turbine Engine Technology (IHPTET) program; 2) The Rocket Propulsion Technology project pursues advances in rocket technologies for space access and maneuver, and tactical and strategic

Page 1 of 26 Pages

Exhibit R-2 (PE 0602203F)

	RDT&E BUDGET ITEM JUSTIFICATIO	N SHEET (R-2 Exhib	oit)	DATE Febru	ary 2002
budo 02 -	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602203F Aerospac	e Propulsion		
(U)	A. Mission Description Continued missiles. Rocket Propulsion Technology project efforts are part of the Im Power project develops efficient energy storage and generation technique develops new concepts and technologies to power, cool, and lubricate new combined cycle and advanced airbreathing hypersonic propulsion technol Congress added \$3.0 million for Pulse Detonation Engines; \$3.0 million for (p-phenylene-2,6-benzobisoxazole) (PBO) Membrane Fuel Cells; \$1.0 m \$1.0 million for lithium ion battery technology for solid state lasers; \$1.5 Jet Engine Test Cell upgrade; \$7.1 million for the IHPRPT program; and Base.	tegrated High Payoff Rocket Prop es for ground, air, and space milita w and existing engines; and 5) The logies to enable revolutionary pro- for magnetic bearing cooling turbi illion for lithium ion battery techr million for Engineering Tool Imp \$10.7 million for Air Force Resea	ulsion Technology ry applications; 4) ' e Advanced Propuls pulsion options for ine; \$1.0 million for tology for aircraft, so provement Program arch Laboratory test	(IHPRPT) program; 3) The Fuels and Lubricat sion Technology project the Air Force. Note: 1 r Poly spacecraft, and handhel for High Cycle Fatigue t stand upgrades at Edv) The Aerospace tion project ct develops (n FY 2002, (d applications; e; \$2.3 million for vards Air Force
(U)	<u>B. Budget Activity Justification</u> This program is in Budget Activity 2, Applied Research, since it develops revolutionary technologies.	s and determines the technical fea	sibility and military	v utility of evolutionary	⁷ and
(U)	C. Program Change Summary (\$ in Thousands)				
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	Total Cost
(U)	Previous President's Budget	123,618	149,211	136,547	
(U) (U)	Appropriated Value	124,762	179,811		
(0)	a Congressional/General Reductions		-1 326		
	b. Small Business Innovative Research	-2.963	-1,520		
	c. Omnibus or Other Above Threshold Reprogram	23,700			
	d. Below Threshold Reprogram				
	e. Rescissions	-1,144			
(U)	Adjustments to Budget Years Since FY 2002 PBR	1110	150 105	-28,888	
(U)	Current Budget Submit/FY 2003 PBR	144,355	178,485	107,659	TBD
(U)	Significant Program Changes: FY 2003 decreases are primarily due to space-related activities being tran	nsferred to new space-unique PE 0	0602500F.		
	Р	age 2 of 26 Pages		Exhibit R-2	e (PE 0602203F)
		106			

	RDT&	E BUDGET ITEM JU	JSTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ary 2002
BUDO 02 -	GET ACTIVITY • Applied Resea i	rch			PE NUMBE 060220	R AND TITLE	space Pr	opulsion			PROJECT 3012
	COST (\$ in Thousands) FY 2001 FY Actual Esti				FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3012	Advanced Propulsi	on Technology	0	21,436	3,637	14,894	12,909	12,903	12,945	Continuing	TBD
Note 681B trans	Note: In FY 2002, the Hypersonic Technology Program work formerly performed in PE 0602203F, Project 3066; PE 0603202F, Project 668A; and PE 0603216F, Project 581B, has been transferred into this Project in order to align projects with the Air Force Research Laboratory organization. In FY 2003, space unquie tasks will be transferred to PE 0602500F, Project 5027, in conjunction with the Space Commission recommendation to consolidate all space-unique activities.										
(U)	A. Mission Description The Advanced Propulsion Technology project develops combined/advanced cycle airbreathing hypersonic propulsion technologies to enable revolutionary propulsion options for the Air Force. These new engine technologies will enable future high-speed weapons, aircraft, and space launch concepts. The primary focus is on hydrocarbon fueled engines capable of operating over a broad range of flight Mach numbers. Technologies developed under this program enable capabilities of interest to both Department of Defense and National Aeronautical and Space Administration (NASA). Efforts include modeling and simulation, proof of concept demonstrations of critical components, advanced component development, and ground-based demonstrations.										
(U) (U) (U)	<u>FY 2001 (\$ in Thous</u> \$0 \$0	<u>ands)</u> This work is performed in PE Total	2 0602203F,	Project 3066	5; PE 060320)2F, Project	668A; and P	PE 0603216F	5, Project 68	1B.	
(U) (U)	 S0 Total FY 2002 (\$ in Thousands) \$14,450 Demonstrate advanced hydrocarbon scramjet engine technology to enable fuller dominance of space. Conduct detailed analysis for mating scramjet flight ready engine with flight demonstrator vehicle. Perform trajectory optimization for flight test. Complete design and component development. Initiate fabrication of flight-ready hydrocarbon fueled scramjet engine, including flight weight fuel cooled structures, flight weight fuel control valves, fuel pump, and engine controller. Evaluate options for scramjet start, including gas generator / heat exchanger system, barbotage fuel injection with plasma ignition, and silane injection with a mechanical throat or air throttle. Demonstrate flight weight scramjet start system through ground testing. Verify operation of engine control techniques, based on rapid shock train identification/characterization coupled with fuel control logic, to ensure stable scramjet operation. \$1,376 Conduct assessments, system design trades, and simulations to integrate combined and advanced cycle airbreathing hypersonic propulsion technologies into future missiles, manned and unmanned air vehicles, and access to space concepts. The goal is to improve warfighting capability and meet Air Force Global Reach/Power needs. Conduct system trade studies to determine military payoff and establish component 										
P	roject 3012			Page	3 of 26 Pag	es			Ex	hibit R-2A	(PE 0602203F)

	RDT&	E BUDGET ITEM JUSTIFICATION	SHEET (R-2A Exhibit)	DATE February 2002					
BUDO		-ch	PE NUMBER AND TITLE	PROJECT					
02 .	- Applieu Resea		0002203F Aerospace Fropulsion	5012					
(U)	A. Mission Descript	ion Continued							
(U)	FY 2002 (\$ in Thous	ands) Continued							
		technology goals. Define component and engine performed Advanced Baccorr	ormance objectives to enable development of affordables by Brainets Agenesy (DABBA)	e hypersonic flight demonstrators					
dD	\$3,030	jointly with NASA and the Defense Advanced Researce Conduct proof-of-concept demonstrations of critical of	cn Projects Agency (DARPA).	Design fabricate and test					
(0)	43,030	sub-scale inlet/combustor/nozzle to identify coupling between engine operating modes and investigate transition between modes. Design and							
		fabricate components capable of withstanding severe t	emperature and acoustic environments, and demonstra	te component structural integrity.					
		Perform ground demonstration of flight-type scramjet	engine operation and performance over a broad flight	speed envelope.					
(U)	\$2,100 Design flowpath for advanced and combined cycle engines to demonstrate operation and performance over a broad flight speed envelope.								
(ID)	Initiate design of advanced and combined cycle engine components for incorporation into advanced and combined cycle demonstrator engines								
(0)	φ + 60	fuel or use silane combustion aid. Investigate magneto	by power source, power conditioning, and control system by drodynamic power generation and extraction from	a hydrocarbon fueled scramiet flow					
		path to provide energy for directed energy weapons an	d plasma generation for hypersonic vehicle drag reduc	ction and scramjet combustion					
		enhancement.							
(U)	\$21,436	Total							
(U)	FY 2003 (\$ in Thous	ands)							
(U)	\$3,637	This project previously included space unique funding	, which has been transferred to PE 0602500F, Project	5027. These funds represent the					
	¢2, 62 7	civilian salaries and in-house support for the work effo	ort transferred and will be transferred at a later date.						
(U)	\$3,637	Total							
(U)	B. Project Change S	<u>ummary</u>							
	Not Applicable.								
(U)	C. Other Program I	<u>'unding Summary (\$ in Thousands)</u>							
(U)	Related Activities:								
(\mathbf{U})	PE 0601102F, Defen	se Research Sciences.							
(0)	PE 0602201F, Aeros	ntional Munitions.							
(U)	PE 0602702E, Tactic	al Technology.							
(U)	PE 0603211F, Aeros	pace Structures.							
P	Project 3012	Page	4 of 26 Pages	Exhibit R-2A (PE 0602203F)					
			100						

RDT&E BUDGET ITEM JUSTIFIC	ATION SHEET (R-2A Exhibit)	DATE February 2002					
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 3012					
 (U) <u>C. Other Program Funding Summary (\$ in Thousands)</u> (U) PE 0603216F, Aerospace Propulsion and Power Technology. (U) PE 0603601F, Conventional Weapons Technology. (U) Program is reported to/coordinated by the Joint Army/Navy/NA. (U) This project has been coordinated through the Reliance process 	SA/Air Force (JANNAF) Executive Committee. to harmonize efforts and eliminate duplication.						
(U) <u>D. Acquisition Strategy</u> Not Applicable.							
 (U) <u>E. Schedule Profile</u> (U) Not Applicable. 							
Project 3012	Page 5 of 26 Pages	Exhibit R-2A (PE 0602203F)					

	RDT&	E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDGET ACTIVITYPE NUMBER AND TITLE02 - Applied Research0602203F Aerospace Propulsion								PROJECT 3048			
	COST (\$ i	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost		
3048	Fuels and Lubricat	ion	8,501	12,549	15,060	16,009	16,201	15,513	14,847	Continuing	TBD
(U)	J) <u>A. Mission Description</u> This project develops improved fuels, lubricants, and combustion concepts for advanced turbine engines, scramjets, and combined cycle engines. Systems applications include missiles, aircraft, and hypersonic vehicles for space access. Fuels and lubricants for these engines must be thermally stable, cost-effective, and operate over a broad range of conditions. Analytical and experimental areas of emphasis include fuels and fuels logistics; advanced combustion and propulsion concepts; and lubricants, bearings, electromagnetic rotor, and oil-less engine technology. Note: In FY 2002, Congress added \$3.0 million for Pulse Detonation Engines.										
(U) (U)	FY 2001 (\$ in Thousands) \$2,298 Developed high thermal stability hydrocarbon fuels to provide higher heat capacity and operating temperatures and reduced pollutant emissions and signatures for aerospace systems. Evaluated a low-cost fuel additive in small-scale laboratory devices and a reduced scale fuel system simulator. This additive could increase JP-8 thermal stability by 225 degrees Fahrenheit and heat sink capacity by five-fold. Evaluated low-cost fuel additives in research scale combustors to reduce pollutant emissions (particulates) by 50% in aircraft engines										
(U)	\$2,839	 low-cost fuel additives in research scale combustors to reduce pollutant emissions (particulates) by 50% in aircraft engines. Developed revolutionary combustion concepts for combined cycle engines and pulse detonation engines. Continued development of novel gas turbine combustor designs including inter-turbine burner. Continued optimization of Trapped Vortex Combustor for inclusion in high performance, low emissions gas turbine engine demonstrators. Conducted preliminary design of pulse detonation engine for military applications. Developed and tested multi-tube, high frequency, demonstrator pulse detonation engine to enable high-performance, low-cost propulsion. Demonstrated an inter-turbine burner concept at representative engine operating conditions. Demonstrated advanced optical 									
(U)	\$2,586	diagnostic techniques for health monitoring and control of advanced military combustors. Continued development of lubrication and diagnostic systems technologies to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants and mechanical systems such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches. Emphasis is placed on demonstrating full-scale magnetic bearing hardware at engine conditions projected for advanced demonstrator engines. Continued maturation of small prototype diagnostic units for engine health monitoring based on evolving needs of near-term production and demonstrator									
(U)	\$778	Developed, formulated, and e scale rigs to reduce particulate	evaluated aff e emissions	ordable adva (i.e., smoke	anced fuel ac and soot) by	lditives using 70%, and ir	g novel synt acrease JP-8	hesis technic fuel high ter	jues, compu nperature st	tational chen ability to 900	nistry, and bench) degrees
Р	roject 3048			Page	6 of 26 Pag	es			E>	hibit R-2A	(PE 0602203F)
	RDT&E	DATE February 2002									
---------------------	--	--	--	--	--	--					
budg 02 -	ET ACTIVITY Applied Resear	PROJECT 3048									
(U)	A. Mission Descripti	on Continued									
(U)) FY 2001 (\$ in Thousands) Continued Fahrenheit and low temperature properties to -70 degrees Fahrenheit. The focus is on enhancing aircraft survivability and operating envelope, and reducing maintenance costs. Developed novel magnetic bearings and vapor phase lubrication concepts for advanced lubrication subsystems. Formulated models to simulate advanced lubrication system behavior										
(U)	\$8,501	Total									
(U)	FY 2002 (\$ in Thousa	unds)									
(U)	\$1,940 Develop low-cost additive approaches to improve fuel properties needed for manned and unmanned systems. Approaches include flow improving additives for low temperature properties to enable replacement of specialty fuels with JP-8; thermal-oxidative and pyrolytic deposit-reducing additives to increase the temperature limit of JP-8 to 900 degrees Fahrenheit; and particulate reducing additives to reduce soot emissions and infrared signature from propulsion systems. Initiate development of a computer model based upon chemical structure-activity relationships for fuel additives design and performance medaling.										
(U)	\$453	Study low-cost approaches to reduce fuel logistics footprint. Screen candidate technologies for fuel field dia improvements in additive packages to reduce logistics footprint.	gnostic techniques. Define								
(U)	\$665	Examine hydrocarbon fuel behavior under conditions encountered in combined and advanced cycle engines is Determine fuel ignition and combustion properties deficiencies. Study high energy density fuels for combined Perform payoff analyses and configuration trade studies to define, focus, and evaluate research in common for space vehicles. Develop modeling and simulation capability for thermal management systems for aerospace	for low-cost access to space. ed cycle engine applications. uels for future military air and vehicles.								
(U)	\$2,730	Develop and evaluate combustor and propulsion concepts for gas turbine, pulse detonation, and combined and manned and unmanned systems. Complete optimization of the trapped vortex combustor for transition to der combustor designs to reduce emissions from gas turbine engines. Demonstrate a highly-swirled ultra-compa combustor of a gas turbine engine. Investigate non-traditional thermodynamic cycles and propulsion system and experimentation. Perform payoff analyses and configuration trade studies to define, focus, and evaluate revolutionary combustor and propulsion concepts. Continue the development of pulse detonation engine tech using hydrocarbon fuel.	nd advanced cycle engines for monstrator engines. Identify act combustor for use as the main s through modeling, simulation, propulsion technology research for mology and evaluate performance								
(U)	\$275	Develop advanced optical and electromechanical diagnostics techniques and devices for fuel systems. Develop propulsion concepts. Investigate pollutant gaseous emissions and particulate formation mechanisms and mit environments.	lop revolutionary combustor and igation techniques in combusting								
P	roject 3048	Page 7 of 26 Pages	Exhibit R-2A (PE 0602203F)								

	RDT&I	DATE February 2002			
BUDG 02 -	GET ACTIVITY - Applied Resea	rch PE NUMBER AND TITLE	PROJECT 3048		
(U)	A. Mission Descript				
(U)	FY 2002 (\$ in Thous	ands) Continued			
(U)	\$1,490	Conduct research to provide the Air Force with reliable and economical advanced lubricants. Develop adv concepts, components, and materials for improved engine performance, affordability, and engine health mo and configuration trade studies to define, focus, and evaluate research in lubricants and mechanical systems	anced bearing and lubricants nitoring. Perform payoff analyses for combined cycle engines.		
(U)	\$2,025	Develop advanced bearing concepts for small- and intermediate-sized turbine and rocket engine application support and power generation concepts, components, and materials for advanced, oil-less engines.	s. Develop electromagnetic rotor		
(U)	 J) \$2,971 Develop the technology to build an airbreathing Pulse Detonation Engine (PDE) for use in an unmanned air vehicle. PDEs offer potential for low-cost propulsion systems that can be applied to unmanned vehicles and eventually high-speed combined cycle engines. Fabricate and integrate key components of the PDE including the inlet, intake valve, fuel injector, initiator, controller, and thrust tube. Initiate development of PDE performance predictive models using experimental data 				
(U)	\$12,549	Total			
(U)	FY 2003 (\$ in Thous	ands)			
(U)	\$2,400	Develop low-cost additive approaches to improve fuel properties needed for manned and unmanned system improving additives for low temperature properties to enable replacement of specialty fuels with JP-8; ther deposit-reducing additives to increase the temperature limit of JP-8 to 900 degrees Fahrenheit; and particula emissions and infrared signature from propulsion systems. Complete development of an initial computer mestructure-activity relationships for fuel additives design and performance modeling.	s. Approaches include flow mal-oxidative and pyrolytic ate reducing additives to reduce soot odel based upon chemical		
(U)	\$1,200	Study low-cost approaches to reduce fuel logistics footprint, including field additization of locally-available fuel. Define improvements in additive packages and fuel dispensing methods to reduce logistics footprint, and additization. Screen candidate technologies for fuel field diagnostic techniques, including on-line quality of the second s	e fuels to produce a JP-8-quality including on-board fuel evaluation ty assessment.		
(U)	\$1,560	Investigate hydrocarbon and other high energy density fuel behavior under conditions encountered in comb access to space. Continue analyses and configuration trade studies to define and evaluate common fuels for vehicles. Assess additive approaches to improve thermal stability and ignition/combustion properties in rec	ined cycle engines for low-cost future aircraft and military fuced scale component testing.		
(U)	\$4,200	Continue development, testing, and evaluation of revolutionary combustor, and propulsion concepts for gas combined and advanced cycle engines for missiles, manned and unmanned systems, and access to space. P along with experiments to identify fuel additives and combustor designs to reduce emissions from gas turbi full-annular ultra-compact combustor at design operating conditions for use as an inter-turbine burner. Inve	turbine, pulsed detonation, and erform modeling and simulation ne engines. Demonstrate a estigate non-traditional		
Р	roject 3048	Page 8 of 26 Pages	Exhibit R-2A (PE 0602203F)		

Γ	RDT&I	DATE February 2002					
BUD0 02 -	GET ACTIVITY • Applied Resea	PROJECT 3048					
(U)	A. Mission Descript	ion Continued					
(U)) FY 2003 (\$ in Thousands) Continued thermodynamic cycles for military propulsion systems through simulation/modeling and experimentation. Continue to perform payoff analyses and configuration trade studies to define, focus, and evaluate propulsion technology research for revolutionary combustor and propulsion concepts. Investigate inlet and nozzle configurations for a pulsed detonation engine and investigate incorporating pulsed detonation propulsion technology into any turbing anging						
(U)	\$500	Develop and demonstrate optical and electromechanical systems. Investigate pollutant emissions formation path gaseous and particulate pollutant emissions from legacy	l diagnostic tools and sensors for application to revol ways through computational and experimental metho y and future gas turbine engines.	utionary combustor and propulsion ods. Evaluate methods to reduce			
(U)	\$1,100	Develop reliable and economical advanced lubricants. economical advanced turbine engine lubricants to the A components, and materials for improved engine perform and configuration trade studies to define, focus, and eva Perform field support activities for aviation lubrication	Continue development, test, and qualification activiti air Force. Develop and test advanced bearing and lub nance, affordability, and engine health monitoring. C aluate research in lubricants and mechanical systems technologies.	es to provide the most reliable and rication system concepts, Continue to perform payoff analyses for combined cycle engines.			
(U)	\$3,100	Develop advanced bearing concepts for small- and inter rotor support and power generation concepts, compone the Integrated High Performance Turbine Engine Techn technology for small- and intermediate-sized turbine er advance design, shorten development time, and reduce generation systems. Commence advanced rotor suppor	rmediate-sized turbine engine applications. Design, f nts, and materials for advanced, oil-less engines, inclu- nology program. Continue development and initiate agine applications. Initiate development of modeling testing requirements for mechanical and electromagn t and power generation studies for Versatile Affordate	abricate, and test electromagnetic uding demonstrators that are part of testing of air and foil bearing and simulation capabilities to etic rotor support and power ole Advanced Turbine Engine			
(U)	\$1,000	 program requirements. Develop thermal management concepts and analysis tools for long-range strike applications of varying speed classes. Conduct fuel trade studies to identify fuel options and capability shortfalls for long-range strike applications. Develop diagnostic approaches and sensors for control of fuel/thermal management systems across the flight envelope. Continue development of engine fuel system and thermal management components identified in Versatile Affordable Advanced Turbine Engine program 					
(U)	\$15,060	Total					
(U)	<u>B. Project Change S</u> Not Applicable.	<u>ummary</u>					
Р	roject 3048	Page 9	9 of 26 Pages	Exhibit R-2A (PE 0602203F)			
			113				

RDT&E BUDGET ITEM JUSTIFICA	DATE February 2002	
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 3048
 (U) <u>C. Other Program Funding Summary (\$ in Thousands)</u> (U) Related Activities: (U) PE 0601102F, Defense Research Sciences. (U) PE 0602805F, Dual Use Science and Technology. (U) PE 0603216F, Aerospace Propulsion and Power Technology. (U) This project has been coordinated through the Reliance process to 	harmonize efforts and eliminate duplication.	
(U) D. Acquisition Strategy Not Applicable.		
 (U) <u>E. Schedule Profile</u> (U) Not Applicable. 		
Project 3048	Page 10 of 26 Pages	Exhibit R-2A (PE 0602203F)

	RDT&	E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	nry 2002
вира 02 -	BUDGET ACTIVITY 02 - Applied Research				PE NUMBE 060220	R AND TITLE	space Pr	opulsion			PROJECT 3066
COST (\$ in Thousands) FY 2001 FY 2002 Actual Estimate				FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost	
3066	Turbine Engine Te	chnology	40,168	44,864	43,630	41,359	38,146	38,025	38,874	Continuing	TBD
Note Rese	: In FY 2002, the Hyp arch Laboratory organ	ersonic Technology Program w ization.	ork in this p	roject will be	e transferred	within this l	PE into Proje	ect 3012, in	order to alig	n projects w	ith the Air Force
	The Turbine Engine reducing weight, fue turbines, internal flov (IHPTET) program, technology on nation Advanced Turbine E	Technology project develops te l consumption, and cost of owne w systems, controls, exhaust sys a joint Department of Defense, al needs. The program also sup ngine. Note: In FY 2002, Cong	chnology to ership. Anal stems, and st National Ae oports design gress added \$	increase turl lytical and ex ructural desi ronautics and a activities for 61.5 million	bine engine of xperimental ign. This pro d Space Adr or the next-g for Engineer	operational r areas of emp oject support ninistration (eneration tur ring Tool De	eliability, du bhasis are fan ts the Integra (NASA), and rbine engine velopment F	arability, mis ns and comp ated High Pe l industry ef developmer Program and	ssion flexibil ressors, high rformance T fort to focus at effort, the \$2.3 millior	lity, and perf n temperature Turbine Engi turbine prop Versatile, A n for Jet Eng	formance while e combustors, ne Technology pulsion ffordable, ine Test Cells.
(U) (U) (U)	<u>FY 2001 (\$ in Thous</u> \$26,308 \$6,762	ands) Developed core engine comp aircraft, bombers, and transpo- consumption, and lower life of complete environmental chara for increased stage loading, re- validation and initiate experin transpiration cooling technolo Developed turbine engine con turbofan/turbojet engines for durability, reduced fuel consu- requirement for complex, hea hardware. Performed elevate thereby reducing thermal load the non-linear control system	onents (com orts. These cycle cost. C acterization. educed stage nental valida ogies and thr nponents (fa fighters, atta unption, and vy, expensiv d fuel temped ling and allo , which simp	apressors, co components Completed ri- Completed e count, and i ation. Fabric ree-dimensio ans, low press ack aircraft, l l lower life c ve variable g erature rig te- bwing increas olifies contro	ombustors, an provide airc g testing of a compressor increased sta cated the spa onal features soure turbine bombers, and cycle cost. R geometry exh sting of the sed thermal ol logic deve	nd high-press raft engines a state-of-the rig testing o Ill margin. I r/shell turbin yielding red s, engine con d transports t ig tested exh aust systems variable disp capacity to b	sure turbines with higher e-art four-sta of a high resp Developed a ne blade with uced cooling ntrols, exhau to provide ai naust nozzle s. Fabricated lacement va be used elsev provides co	s) for turbofa performance ge compress ponse air val reduced ord h enhanced i g air at highe st nozzles, a rcraft engine hardware ca d contoured ne pump, where in the mponent per	an/turbojet e e, increased sor and deliv ve for active er model for nternal conv er design ope nd integratio es with high pable of flui ceramic con nich elimina weapon syst formance tr	ngines for fig durability, re- rered to core stability con intentional fig- rection and li- crating tempe on technolog er performan- idic injection nposite exhau- tes fuel recir em. Comple end data.	ghters, attack educed fuel engine for ntrol capability mistuning imited eratures. y) for ce, increased to delete the ust nozzle culation to tanks, eted design of
Р	roject 3066			Page	11 of 26 Pag	ges			Ex	hibit R-2A	(PE 0602203F)
					115						

	RDT&E	DATE February 2002				
вирс 02 -	SET ACTIVITY Applied Resear	Ch PE NUMBER AND TITLE Ch 0602203F Aerospace Propulsion	PROJECT 3066			
(U)	A. Mission Descripti	on Continued				
(U) (U)	FY 2001 (\$ in Thousa \$3,673	nds) Continued Developed components for expendable engines for missile and unmanned air vehicle applications to provide cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of low-cost ceramic turbine blades yielding reduced need for cooling air and higher performance.	e expendable engines with reduced cruise missiles. Fabricated			
(U)	\$1,776 Developed components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports. Initiated rig testing of splittered, forward swept compressor rotor to validate high efficiency, high stage loading design, leading to angines with reduced fuel consumption fewer parts, and lower production and maintenance.					
(U)	 \$1,649 Designed, developed, and tested propulsion components to demonstrate performance and durability of advanced hypersonic propulsion concepts in support of Defense Advanced Research Projects Agency (DARPA) missile demonstration. Continued testing of scramjet engine components (e.g., inlet, combustor, and nozzle) capable of demonstrating positive thrust at Mach 4-8 while withstanding severe internal conditions 					
(U)	\$40,168	Total				
(U) (U)	<u>FY 2002 (\$ in Thousa</u> \$28,179 \$6,900	nds) Develop core turbine engine components (compressors, combustors, and high-pressure turbines) for turbofa attack aircraft, bombers, and transports. These components enable aircraft engines with higher performance consumption, and lower life cycles costs. Design and fabricate a high-pressure ratio compressor including a reduced fuel burn, and high reaction blading and engine stall avoidance techniques for reduced maintenance performance, reduced emissions combustor technologies. Conduct analytical and experimental evaluations fuel-air mixing, and liner cooling techniques. Develop affordable, robust, lightweight, and compact combust Lightweight Combustor or Trapped Vortex Combustor configurations. Conduct environmental and structur blade with enhanced internal convection, limited transpiration cooling technologies, and three-dimensional f high design operating temperatures. Rig test a non-contacting stress measurement system allowing durable of rotating blades. This technology enables replacements for limited life strain gages, reducing core engine maintenance costs. Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integ turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components enable air performance, increased durability, reduced fuel consumption, and lower life cycle cost. Validate the contor	un/turbojet engines for fighters, , increased durability, reduced fuel n active stability control system for costs. Develop improved of combustor aerodynamics, stors such as the Integrated al evaluation of spar/shell turbine ceatures to reduce cooling air at measurement of vibratory response components development and gration technology) for craft engines with higher ired ceramic composite exhaust			
Ρ	roject 3066	Page 12 of 26 Pages	Exhibit R-2A (PE 0602203F)			

	RDT&I	DATE February 2002					
BUDO 02 -	GET ACTIVITY - Applied Resea	PROJECT 3066					
(U)	A. Mission Descript	ion Continued					
(U)	FY 2002 (\$ in Thous	ands) Continued nozzle hardware in a high temperature environment. Evaluate temperature, pressure, and vibration of integra engine. Complete reliability testing of variable displacement vane pump system to eliminate fuel recirculation and increase weapon system thermal capacity. Complete fabrication of the non-linear control system to simp provide component performance trend data.	ated components in a demonstrator on to tanks, reduce thermal loading, lify control logic development and				
(U)	\$3,711	Develop components for limited life engines for missile and unmanned air vehicle applications. These comp reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envel unmanned vehicles. Rig test a composite forward swept fan for reduced weight, improved efficiency, and lo turbine blades to reduce cooling air and enhance performance.	oonents enable engines with opes of cruise missiles and wer cost. Rig test low-cost ceramic				
(U)	\$2,311	Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports. Complete rig testing the splittered, forward swept compressor rotor to validate high efficiency, high stage loading design. The components enable engines with reduced fuel consumption and lower production and maintenance costs					
(U)	\$2,278	Upgrade jet engine compressor and turbine aerodynamic test cells to enable assessment of emerging Air Fore supporting fighter and bomber transformational requirements. Increase power capability to 6000 horse powe capability for these facilities.	ce jet engine technologies r and develop counter-rotating				
(U)	\$1,485	Develop modeling and simulation tools to analyze and predict the performance of aerospace engines and the tools associated with aerospace engines with the main focus on high performance, long life, advanced coolin stability.	ir components. Improve analytical g techniques, and combustion				
(U)	\$44,864	Total					
(U)	FY 2003 (\$ in Thous	ands)					
(U)	\$30,380	Develop core engine components (compressors, combustors, and high-pressure turbines) for turbofan/turboje aircraft, bombers, long-range strike/next generation bombers, and transports. These components enable aircr performance, increased durability, reduced fuel consumption, and lower life cycle cost. Perform testing on a including an active stability control system for reduced fuel burn, and high reaction blading and engine stall maintenance cost. Conduct testing on an active combustion control high response fuel valve to reduce acoust enhance overall combustion efficiency resulting in fuel burn reduction. Complete subscale rotational intention initiate application of methodology to transonic rig hardware. Modify the spar/shell turbine blade design systems	et engines for fighters, attack raft engines with higher high-pressure ratio compressor avoidance techniques for reduced stically coupled fatigue and onal mistuning experiment and stem using component bench test				
P	Project 3066	Page 13 of 26 Pages	Exhibit R-2A (PE 0602203F)				
		117					

	RDT&E B	DATE February 2002				
BUDO 02 -	GET ACTIVITY • Applied Research		PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 3066		
(U)	A. Mission Description (Continued				
(U)	FY 2003 (\$ in Thousands)	Continued				
(U)	 results and transition this technology to engine demonstrator testing. \$7,750 Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, long-range strike/next generation bombers, and transports. These components enable aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost. Conduct testing of a non-linear control system to simplify control logic development and provide the component performance trend data necessary for transitioning 					
(U)	 \$3,700 this technology to the demonstrator engine program. \$3,700 Develop components for limited life engines for missile and unmanned air vehicle applications. These components enable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles and unmanned vehicles. Conduct rig test of an enhanced fan flow control treatment for an all-composite, forward swept shrouded rotor. Design rub televant correming for an educated turbing rotor blades. 					
(U)	 \$1,800 \$1,800 Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports. Conduct durability tests of Ceramic Matrix Composite materials under high temperature/high pressure/high moisture conditions to validate composite integrity and life models. Perform rig tests to demonstrate the feasibility of a very high fuel/air ratio combustor with supercritical fuel delivery system. 					
(U)	\$43,630 Tot	al				
(U)	<u>B. Project Change Summ</u> Not Applicable.	nary				
(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	 C. Other Program Funding Summary (\$ in Thousands) Related Materials: PE 0601102F, Defense Research Sciences. PE 0602102F, Materials. PE 0603216F, Aerospace Propulsion and Power Technology. PE 0602122N, Aircraft Technology. PE 0603210N, Aircraft Propulsion. PE 0603003A, Aviation Advanced Technology. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. 					
Р	Project 3066	Page 1	4 of 26 Pages	Exhibit R-2A (PE 0602203F)		

RDT&E BUDGET ITEM J	DATE February 2002	
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 3066
(U) <u>D. Acquisition Strategy</u> Not Applicable.		
 (U) <u>E. Schedule Profile</u> (U) Not Applicable. 		
Project 3066	Page 15 of 26 Pages	Exhibit R-2A (PE 0602203F)

	RDT&I	E BUDGET ITEM JU	STIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDO 02 -	BUDGET ACTIVITY PE NUMBER AND TITLE 02 - Applied Research 0602203F Aerospace Propulsion									PROJECT 3145	
	COST (\$ in Thousands)FY 2001 ActualFY 2002 EstimateFY 2003 EstimateFY 2004 EstimateFY 2005 EstimateFY 2006 Estimate						FY 2007 Estimate	Cost to Complete	Total Cost		
3145	Aerospace Power	Technology	26,727	27,376	26,890	27,831	28,090	28,688	29,266	Continuing	TBD
(U)	5) A. Mission Description This project develops techniques for efficient energy generation and storage for military ground, air, and space applications. Power component technologies are developed to increase reliability, maintainability, commonality, and supportability of aircraft and flight line equipment. Research in power storage technologies enables the 10-20 year long-term energy storage goals of Air Force unmanned vehicles. Electrical power generation and thermal management technologies are enabling for all future military directed energy weapon systems. This project supports development of very high output power systems suitable for applications to air moving target indication (AMTI) radar, high power lasers for air and space platforms, and orbiting/maneuvering vehicles. Lightweight power systems suitable for other space applications are also developed. Note: In FY 2002, Congress added \$3.0 million for magnetic bearing cooling turbine; \$1.0 million for Poly (p-phenylene-2,6-benzobisoxazole) (PBO) Membrane Fuel Cells; \$1.0 million for lithium ion battery technology for aircraft, spacecraft, and handheld applications, and \$1.0 million for lithium ion battery technology for aircraft, spacecraft, and handheld applications,										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$5,479	ands) Developed power generation, for manned and unmanned air while reducing life cycle cost free battery technology by tes	conditionin craft system s and enablisting cells and	g, and distril ns. These tec ng new capa d batteries to	oution; energ chnologies ir bilities. Co o load profile	gy storage; a nprove aircr ntinued deve es specified	nd thermal n aft self-suffi elopment of in performat	nanagement ciency, relia high energy nce requirem	component bility, main density lithi ents for airc	and subsyste tainability, a um ion cell a traft.	m technologies nd supportability and maintenance
(U)	\$8,633	Developed thermal management, energy storage, and power conditioning components, and subsystem technologies for air moving target indication radar, high power lasers for space platforms, and orbiting/maneuvering vehicles. Continued development of high energy density polycrystalline capacitors, high voltage/high power diamond switches, and distributed power for laser diodes to enable high power lasers on air and space platforms. Developed small-scale heat pipes for passive power electronics cooling for improved power density. Evaluated cycle life									
(U)	\$470	Developed cryogenic power generation, high rate batteries, energy storage and power conditioning components, and system technologies with low volume displacement for delivery of high power for operation of directed energy weapons. Continued development of Yttrium Barium Compar Oxida, coated conductors									
(U)	\$956	Designed, fabricated, and eva weapons for space and aircraft	luated lithiu t, burst com	m ion cells f	or battery and devices, and	oplications fo on-the-soldi	or high powe er weapons	er military re and commu	equirements	such as pulse uipment.	e power
Р	roject 3145			Page	16 of 26 Pag	ges			Ex	hibit R-2A	(PE 0602203F)

	RDT&I	DATE February 2002			
вирс 02 -	GET ACTIVITY - Applied Resear	PE NUMBER AND TITLE O602203F Aerospace Propulsion	PROJECT 3145		
(U)	A. Mission Descript				
(U)	FY 2001 (\$ in Thous	ands) Continued			
(U)	\$3,634	Continued development of turbomachinery incorporating magnetic bearings to provide augmented cooling as systems. Designed and fabricated ground test turbomachinery equipment for aircraft application. Evaluated meet directed energy weapon and Expeditionary Air Force ground support power applications.	nd electrical power to Air Force feasibility of magnetic bearings to		
(U)	\$2,486	Developed the Poly(p-phenylene-2, 6-benzobisoxazole) (PBO) membrane for use in Proton Exchange Membrane for use in Proton Exchange Membranes.	brane direct methanol fuel cells.		
(U)	\$1,721	Modified the Variable Displacement Vane Pump (VDVP) design for test on an engine with commercial appl design for advanced tactical aircraft applications and evaluated initial endurance and damage tolerance.	ications. Fabricated a VDVP		
(U)	 \$3,348 Initiated concepts for an integrated vehicle-power-generation-weapon system. Initiated simulation and design of electrical components for magneto-hydrodynamic (MHD) and electro-magneto-hydrodynamic power systems to provide high power sources for hypersonic systems and directed energy weapons. Enables MHD pressure control of hypersonic engine inlet. 				
(U)	\$26,727	Total			
(U)	FY 2002 (\$ in Thous	ands)			
(U)	\$9,663	Develop power generation, conditioning, and distribution; energy storage; and thermal management compon manned and unmanned aircraft systems. These technologies improve aircraft self-sufficiency, reliability, ma while reducing life cycle costs and enabling new capabilities. Fabricate and begin evaluation of advanced sw controllers. Initiate fabrication of Inverter Converter Controller to demonstrate power denisty improvements. energy density lithium ion cell and maintenance free battery technology by testing cells and batteries to load requirements for aircraft. Initiate development of lithium polymer cells. Complete design of low-cost, long air vehicle systems. Develop and test magnetic materials for high temperature generator and magnetic bearing	ent and subsystem technologies for intainability, and supportability itched reluctance machine . Continue development of high profiles specified in performance duration fuel cells for unmanned ng aircraft applications.		
(U)	\$6,236	Develop thermal management, energy storage and power conditioning components, and subsystem technolog Fabricate an integrated Power Management and Distribution system for space-based distributed power system volume of conventional approaches. Demonstrate radiation-hardened power semiconductor device. Continue density polycrystalline capacitors, high voltage/high power diamond switches, and distributed power for lase power lasers on air and space platforms. Test cycle life of high energy density lithium ion cells and batteries Evaluate mechanical pumped-loop for higher power spacecraft. Continue work on active two-phase thermal	gies for space applications. ns that are half the weight and le development of high energy r diodes to enable the use of high s for long-term space applications. management technologies.		
(U)	\$5,534	Develop cryogenic power generation, high rate batteries, energy storage and power conditioning components	s, and system technologies with		
Р	Project 3145	Page 17 of 26 Pages	Exhibit R-2A (PE 0602203F)		

	RDT&E	DATE February 2002			
BUDG 02 -	BET ACTIVITY Applied Resear	PROJECT 3145			
(U)	A. Mission Descripti	on Continued			
(U)	FY 2002 (\$ in Thousa	nds) Continued low volume displacement. These technologies enable delivery of high power for operation of directed energy high density power conditioning for directed energy weapon systems. Develop high rate (pulse power) Lithin development of a thermal management system for cryogenic generator applications.	y weapons. Complete designing um Ion batteries. Begin		
(U)	\$2,970	Develop and demonstrate magnetic bearings for cooling turbine/power generation systems. Magnetic bearing package reliability and longer life cycles over conventional turbine systems with rolling element bearings or the controls for an integrated cooling turbine-generator trim load and advanced magnetic bearing cooling turbine-	gs provide increased cooling air bearings. This task optimizes bine systems.		
(U)	\$991	Develop Poly(p-phenylene-2, 6-benzobisoxazole) (PBO)-based membrane fuel cells. PBO membrane fuel c weight, higher performance, and more energy efficient fuel cell over existing proton exchange membrane fue fabrication for a prototype PBO-based membrane in a single cell configuration.	ells offer a lower cost, lighter el cells. Initiate design and		
(U)	 \$991 Develop large ampere-hour rechargeable lithium-ion cell battery technology for future spacecraft and aircraft. Lithium-ion batteries offer advantages over conventional systems by storing the same amount of energy at one-fourth the weight. Potential applications for rechargeable lithium-ion batteries include satellite energy storage, manned and unmanned aircraft, planetary orbiters, and ground support equipment. Initiate development of large ampere-hour cells that address cycle life technical issues for aircraft and Low Earth Orbit space applications and also 				
(U)	\$991	Develop high pulse power rechargeable lithium-ion cell battery technology that maximizes current capacity of for solid state lasers. Potential high power military applications could include pulse power weapons for space focus on proper design and fabrication techniques beginning with relatively small ampere-hour cells.	under high discharge rates required ecraft and aircraft. This effort will		
(U)	\$27,376	Total			
(U)	FY 2003 (\$ in Thousa	<u>nds)</u>			
(U)	\$9,850	Develop power generation, conditioning, and distribution; energy storage; and thermal management compon manned and unmanned aircraft systems. These technologies improve aircraft self-sufficiency, reliability, ma while reducing life cycle costs and enabling new capabilities. Conduct testing of advanced switched reluctar and conduct tests on full-scale lithium ion batteries and fuel cells for manned and unmanned vehicles. Conti polymer cells.	ent and subsystem technologies for aintainability, and supportability ace machine controllers. Fabricate nue development of lithium		
(U)	\$5,340	Develop thermal management, energy storage and power conditioning components, and subsystem technolog Test and demonstrate an integrated Power Management and Distribution system for space-based distributed	gies for aerospace applications. power systems that are half the		
Р	roject 3145	Page 18 of 26 Pages	Exhibit R-2A (PE 0602203F)		

BUDGET ACTIVITY	arch	PE NUMBER AND TITLE							
		0602203F Aerospace Propulsion	3145						
(U) <u>A. Mission Descri</u>	ption Continued								
(U) <u>FY 2003 (\$ in Tho</u>	isands) Continued								
(U) \$9,700	weight and volume of conventional approaches. Fabr Develop cryogenic power generation, high rate batteri low volume displacement. These technologies enable density power conditioning for directed energy weapo	es, energy storage and power conditioning components delivery of high power for operation of directed energy n systems. Continue developing high rate (pulse power	ace spacecraft applications. s, and system technologies with y weapons. Fabricate and test high r) lithium ion batteries. Initiate						
(U) \$2,000	 testing of a thermal management system with Yttrium Barium Copper Oxide coated wire and coils for cryogenic generator applications. \$2,000 Develop high density electrical power system and thermal management technologies for a next generation aerospace long-range strike vehicle. Develop power and thermal requirements for a long-range strike aircraft incorporating advanced weapon systems and initiate compact high power conditioning, energy storage, and thermal management component designs that optimize secondary power system size, weight, and efficiency. 								
(U) \$26,890	Total								
(U) <u>B. Project Chang</u> Not Applicable.	Summary								
 (U) <u>C. Other Program</u> (U) Related Activities: (U) PE 0601102F, Deff (U) PE 0602102F, Aero (U) PE 0602605F, Dire (U) PE 0602805F, Dua (U) PE 0603205, Fligh (U) PE 0603205F, Adv (U) PE 0603216F, Aero (U) This project has be 	Funding Summary (\$ in Thousands) nse Research Sciences. space Flight Dynamics. cted Energy Technology. Use Science and Technology. Vehicle Technology. anced Weapon Technology. space Propulsion and Power Technology. en coordinated through the Reliance process to harmonize	efforts and eliminate duplication.							
(U) <u>D. Acquisition Str</u>	<u>itegy</u>								
(U) E. Schedule Profil									
Project 3145	Page	19 of 26 Pages	Exhibit R-2A (PE 0602203F)						

RDT&E BUDGET ITEM JUST	DATE February 2002	
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 3145
 (U) <u>E. Schedule Profile Continued</u> (U) Not Applicable. 		
Project 3145	Page 20 of 26 Pages	Exhibit R-2A (PE 0602203F)
	124 UNCLASSIFIED	

	RDT&	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ary 2002
BUD0 02 •	GET ACTIVITY • Applied Resea	rch			PE NUMBE 060220	R AND TITLE	space Pr	opulsion			PROJECT 4847
	COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4847	Rocket Propulsion	Technology	68,959	72,260	18,442	18,865	19,214	19,545	20,049	Continuing	TBD
Note cons	: In FY 2003, space un olidate all space-unique	nique tasks in this project will b e activities.	e transferred	to PE 0602.	500F, Projec	et 5026, in co	onjunction w	ith the Space	e Commissio	on recomme	ndation to
(U)	A. Mission Description This project develops advances in rocket technologies for space access, maneuver, and for tactical and strategic missiles. Analytical and experimental areas of emphasis are propellants, combustion, rocket materials, strategic sustainment, and novel space propulsion concepts. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of future space and missile launch sub-systems. Technologies are developed to reduce the weight and cost of components using new materials, and improved designs and manufacturing techniques. All efforts in this project are part of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program, a joint Department of Defense, National Aeronautics and Space Administration (NASA), and industry effort to focus rocket propulsion technology on national needs. Note: In FY 2002, Congress added \$7.1 million for the Integrated High Payoff Rocket Propulsion Technology Program and \$10.7 million for upgrading. Air Force Research Laboratory Test Stands at Edwards Air Force Base										
(U) (U)	 error to rocus rocket propulsion technology on national needs. Note: in FY 2002, Congress added \$7.1 million for the integrated High Payoff Rocket Propulsion Technology Program and \$10.7 million for upgrading Air Force Research Laboratory Test Stands at Edwards Air Force Base. <u>FY 2001 (\$ in Thousands</u>) \$4,433 Developed high-energy density and non-toxic propellants for increased space launch payload capability. Refined production of lab-scale quantities of high-energy density propellants with additives at desired concentrations in preparation for scale-up to maximize future propulsion system performance. Scaled-up selected propellants for testing and evaluation. Continued to develop, characterize, and model new and advanced propellants for scale-up and testing. Optimized synthetic routes for polymer binders and fuel formulations with specific impulse (Isp) exceeding that available from current systems. Developed high-energy oxidizer formulations for combustion with high-energy fuels to yield greatly enhanced performance. Continued research in the area of low-cost, non-toxic mono-propellants for current and future launch systems. Characterized, studied, and evaluated selected propellants in advanced combustion devices to determine compatibility and performance. Developed and characterized advanced propellants for use in revolutionary launch and spacecraft propulsions systems. Provided technical expertise for the continued use of energetic chemical rocket propellants in existing rocket propulsion systems. \$2,793 Developed advanced liquid engine combustion technology for improved performance with application to combustor chamber/injector compatibility to prevent damage to test and operational combustion devices: continued to support commercially developed 										
F	Project 4847			Page	21 of 26 Pag	ges			Ex	hibit R-2A	(PE 0602203F)
					125						

	RDT&I	DATE February 2002							
BUD0 02 ·	GET ACTIVITY - Applied Reseal	ch	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 4847					
(U)	A. Mission Descript	on Continued							
(U)	FY 2001 (\$ in Thous	<u>ands) Continued</u> compatible with new energetic propellants. Deve concepts with enhanced performance and reliabil	eloped and evaluated through analysis and modeling advan	ced/revolutionary propulsion					
(U)	 \$5,111 Continued to develop advanced material technology for lightweight components and material property enhancements for use in launch and space systems. Developed advanced ablative components using hybrid polymers for use in current and future launch systems. Characterized and developed new high temperature polymers and carbon-carbon materials for use in advanced combustion devices and advanced propulsion systems, for lower weight and increased strength requirements. Developed advanced materials for use with high-energy propellants. Transitioned advanced high temperature materials to the commercial industry and Air Force systems for reduced system weight/cost and increased performance 								
(U)	\$2,092	\$2,092 Continued the development of analytical tools for prediction of propellant life. Continued the transition to industry the tools and techniques used to determine the age life of strategic systems and other solid rocket motors							
(U) (U)	\$18,735 \$6,975	Continued to develop propulsion component tech design and processing techniques for high-streng development of advanced lightweight rocket engi- high discharge pressure turbopump for advanced for space boosters and air launched missiles. Con continue to develop turbomachinery, combustion development of high temperature oxygen rich tur advanced Aluminum Metal Matrix Composite M characterizing new refractory combustion materia Verified performance and weight improvements of ballistic missiles. Continued to demonstrate low-opolymer components for solid rocket space boost stage and space booster applications. Continued of rocket engines with dramatic weight reductions. and storable). Initiated feasibility studies concern Continued development of missile propulsion tec sustainment of current Intercontinental Ballistic M	nology for reliable, safe, and low-cost boost and orbit tran th, low-weight engine and motor components (metals and a ine nozzle for upper stage and space booster applications. I cryogenic engines. Continued to develop liquid oxidizer for tinued developing and demonstrating advanced materials f devices, and propellant management devices for solid and bine materials for applications to oxidizer rich turbomachi- aterials to rocket turbomachinery housings and rocket strue als and devices to apply to liquid-propellant rocket enginess of rapid densification nozzle technology using improved st cost, high temperature, non-erosive, lightweight coated car ers and missiles. Fabricated and tested advanced lightweig characterizing new refractory combustion materials and dev Continued to develop and characterize components applica- ning rocket based combined cycle engines. hnology, aging and surveillance technology, and Post Boo Missile fleet. Completed development of compatible case/	sfer systems. Continued to develop non-metals). Continued nitiated development of a low-cost, or hybrid propulsion technologies for rocket engine components and liquid rockets. Continued nery. Continued application of ctural hardware. Continued with dramatic weight reductions. rategic propellants for future bon-carbon ceramic and hybrid ght rocket engine nozzle for upper vices to apply to liquid-propellant able to liquid propulsion (cryogenic st Control Systems (PBCS) for iner, insulator, and case systems for					
F	Project 4847	I	Page 22 of 26 Pages	- Exhibit R-2A (PE 0602203F)					
			126						

BUDGET ACTIVITY PE NUMBER AND TITLE 02 - Applied Research 0602203F Aerospace Propulsion (U) A. Mission Description Continued (U) FY 2001 (\$ in Thousands) Continued (U) FY 2001 (\$ in Thousands) Continued bigher combustion temperature propellants. Completed design and begin fabrication of solid rocket motor test hardware. If develop an advanced lightweight solid rocket motor. Continued development of tools to increase the capability to determing strategic systems and other solid rocket motors. Completed the development of the advanced PBCS. Continued to development of the advanced PBCS.	PROJECT 4847 re. Initiated a project to rmine the service life of velop technologies that t of the next generation rbit transfer for large						
 (U) <u>A. Mission Description Continued</u> (U) <u>FY 2001 (\$ in Thousands) Continued</u> higher combustion temperature propellants. Completed design and begin fabrication of solid rocket motor test hardware. I develop an advanced lightweight solid rocket motor. Continued development of tools to increase the capability to determi strategic systems and other solid rocket motors. Completed the development of the advanced PBCS. Continued to develop are readily available over the life of strategic systems, which may also be potentially advantageous to the development of 	re. Initiated a project to rmine the service life of velop technologies that t of the next generation rbit transfer for large						
 (U) <u>FY 2001 (\$ in Thousands) Continued</u> higher combustion temperature propellants. Completed design and begin fabrication of solid rocket motor test hardware. I develop an advanced lightweight solid rocket motor. Continued development of tools to increase the capability to determing strategic systems and other solid rocket motors. Completed the development of the advanced PBCS. Continued to develop are readily available over the life of strategic systems, which may also be potentially advantageous to the development of the advantageous to the advantageous to the advantageous to the advantageous to the advant	re. Initiated a project to rmine the service life of velop technologies that t of the next generation rbit transfer for large						
(U) <u>FY 2001 (\$ in Thousands) Continued</u> higher combustion temperature propellants. Completed design and begin fabrication of solid rocket motor test hardware. I develop an advanced lightweight solid rocket motor. Continued development of tools to increase the capability to determi strategic systems and other solid rocket motors. Completed the development of the advanced PBCS. Continued to develop are readily available over the life of strategic systems, which may also be potentially advantageous to the development of	re. Initiated a project to rmine the service life of velop technologies that t of the next generation rbit transfer for large						
strategic systems.	rbit transfer for large						
 \$5,120 Continued developing solar electric and solar thermal propulsion technologies for stationkeeping, repositioning, and orbit transfer for large communication satellites and satellite constellations. Continued Hall thruster development efforts to meet Air Force need for orbit transfers using electric propulsion. Continued development of propulsion systems, including pulsed plasma thrusters, for microsatellites (< 25 kg) needed for advanced Air Force imaging missions. Continued developing solar thrusters and concentrators for future orbital transfer vehicles. Performed preliminary characterization of concentrator surface roughness. Fabricated an advanced solar thermal thruster and integrate with an inflatable concentrator. Began development of an electrically controlled solid propellant 							
(U) \$12,600 Upgraded and activated rocket engine test stand to enable system level research and test capabilities for new and existing Upgraded test stand for liquid oxygen/kerosene engine research. Prepared test stand to support Integrated High Payoff Romer Technology hydrocarbon boost engine test.	ing rocket engines. f Rocket Propulsion						
(U) \$11,100 Upgraded and activated rocket component test stand 2A at Edwards Air Force Base, California, to support component lev advanced rocket propulsion systems. Installed high-pressure piping and data acquisition system components.	level research of						
(U) \$68,959 Total							
(U) <u>FY 2002 (\$ in Thousands)</u>							
(U) \$5,122 Develop, characterize, and test strained-ring, unsaturated hydrocarbons and energetic, reduced-toxicity monopropellants to launch payload capability. Refine synthesis methods of new propellants to facilitate the transition from producing lab-scar producing sufficient material to meet operational requirements. Continue scale up of selected propellants for laboratory a engine evaluations. Develop high-energy-density oxidizers and polymeric binders (i.e., linked heterocyclic compounds), incorporating these materials into propellants with significantly enhanced performance. Continue evaluating the potential comprised of reduced-toxicity ionic salts to reduce the cost of space access and space operations. The goal is monoproper performance equivalent to bipropellants. Continue to evaluate selected propellants in advanced combustion devices to de compatibility and performance.	ats to increase space -scale quantities to ry and demonstrator ls), and optimize paths for ntial of monopropellants opellants with o determine materials						
Project 4847 Page 23 of 26 Pages Exhibit F	it R-2A (PE 0602203F)						

	RDT&E	DATE February 2002		
BUD0 02 -	GET ACTIVITY - Applied Resear	ch	PE NUMBER AND TITLE 0602203F Aerospace Prop	PROJECT 4847
(U)	A. Mission Descripti	on Continued		
(U) (U)	<u>FY 2002 (\$ in Thousa</u> \$2,475	<u>Inds) Continued</u> Develop advanced liquid engine space vehicle engines. Continue damage to test and operational c compatible with new energetic p	e combustion technology to improve performance while preser e to characterize, study, and evaluate injector performance to e combustion devices. Continue to develop, analyze, and model propellants. Continue to model and analyze advanced propuls ad lighteraft and rocket based combined cycle angines	rving chamber lifetime and reliability in heavy lift ensure chamber/injector compatibility and prevent advanced combustion devices and injectors ion concepts with enhanced performance and
(U)	\$3,036	Develop advanced technologies advanced ablative components u high temperature polymers and and increased strength requirem advanced high temperature mate	and material property enhancements for lightweight components using hybrid polymers for use in current and future launch systic carbon-carbon materials for use in advanced combustion devi- tion materials for use in advanced materials for use with his erials to Air Force systems to reduce system weight and cost, a	ents for use in launch and space systems. Develop tems Continue to characterize and develop new ces and propulsion systems to meet lower weight gh-energy propellants. Complete and transition and increase performance.
(U)	\$12,600	Develop propulsion component advanced lightweight rocket eng pressure turbopump for advance Continue to develop turbomachi temperature turbine materials fo and space booster applications. strategic propellants for future b carbon-carbon ceramic and hybr	technology for reliable, safe, and low-cost boost and orbit tran- gine nozzle for upper stage and space booster applications. Co- ed cryogenic engines. Develop components for hybrid propuls- inery, combustion, and propellant management devices for sol- or oxidizer rich applications. Continue developing advanced li- Verify performance and weight improvements of rapid densif- ballistic missiles. Continue to demonstrate low-cost, high temp rid polymer components for solid rocket motors. Develop new	hsfer systems. Complete development of ontinue development of a low-cost, high discharge sion for space boosters and air-launched missiles. id and liquid rockets. Continue developing high ghtweight rocket engine nozzles for upper stage fication nozzle technology using improved perature, non-erosive, lightweight coated v fuels and oxidizers for advanced solid
(U)	\$7,038	Develop missile propulsion tech Intercontinental Ballistic Missile enhance the capability to determ Post Boost Control Systems. Co	nology, aging and surveillance technology, and Post Boost Co e fleet. Continue to develop an advanced lightweight solid roc nine the service life of strategic systems and other solid rocket complete efforts for prediction of solid motor life and transitior	ontrol Systems for sustainment of current of control Systems for sustainment of controls to motors. Begin full-scale testing of the advanced into damage assessment models.
(U)	\$7,375	Develop solar electric and them satellites and satellite constellati Continue development of micro developing solar thrusters and c	hal propulsion technologies for stationkeeping, repositioning, ions. Continue Hall thruster development efforts to achieve Ai satellites (< 25 kg) propulsion systems (e.g., plasma thrusters) oncentrators for future orbital transfer vehicles. Evaluate elec	and orbit transfer for large communication ir Force orbit transfers using electric propulsion. for advanced imaging missions. Continue trically controlled solid propellant. Design high
F	Project 4847		Page 24 of 26 Pages	Exhibit R-2A (PE 0602203F)
			128	

	RDT8	DATE February 2002		
BUD0 02 -	GET ACTIVITY - Applied Resea	PROJECT Ision 4847		
(U)	A. Mission Descri	otion Continued		
(U)	FY 2002 (\$ in Thou	usands) Continued		
(U)	\$11,985	power solar thermal compose Develop materials and proc candidate materials for rock and Advanced Composites the applications of these ma property databases and initi	nents esses to dramatically improve performance, durability, and cost of re- cet engines such as Metal Matrix Composites, Discontinually Reinfor for use in liquid oxygen, liquid hydrogen, high-temperature, and high terials to turbopump housings, ducts, valves, solid rocket casings, in ate demonstration of suitability for application using representative g	ocket propulsion systems. Evaluate new rced Materials, Ceramics, Ceramic Metallics, h-pressure environments. Identify and evaluate sulation, and nozzle throats. Develop material geometry and processing conditions for the
(U)	\$5,000	intended rocket engine com Develop rocket component to establish optimum propu propellants. Initiate hydroca transfer. Evaluate rocket er hydrocarbon propellants. E	ponents. of a hydrocarbon fueled rocket based combined/combination cycle e lsion cycle and operating conditions. Initiate detailed design of high urbon thrust chamber design, focusing on affordable, lightweight man agine health management and prognostic systems. Initiate scale-up a valuate combustion and thermal stability properties of select new hy-	ngine for rapid acess to space. Initiate studies pressure turbopumps for hydrocarbon terials and propellants to provide optimal heat and testing of new high density strained-ring ydrocarbon propellants. Produce sufficient
(U)	\$7,032	Conduct risk reduction effo alternate, high temperature System propulsion material propellant synthesis and sca applications. Conduct inter	rts on the Integrated High Payoff Rocket Propulsion Technology (IH material into the hot gas valve for development and testing of lower s, a key portion of the Technology for the Sustainment of Strategic S lle-up critical for meeting IHPRPT goals to significantly reduce cost im demonstrations of subsystems (propellant, case, nozzle, and insul	PRPT) program. This includes adding an cost, higher performance Post Boost Control systems program. Conduct solid and liquid -per-pound of payload to orbit for space launch lation) for missile propulsion demonstration uch as the TechSet 21 flight experiment
(U)	\$10,597	Complete refurbishment and liquid rocket test capability capability on Test Stand 1D	d modernization of a large liquid rocket engine test stand and a comp at Edwards Air Force Base. Perform modifications necessary to acc	contract stand to meet increased demand for commodate multiple users and broader uid storage and more test configurations
(U)	\$72,260	Total		and storage and more test configurations.
F	Project 4847		Page 25 of 26 Pages	Exhibit R-2A (PE 0602203F)
			129 UNCLASSIFIED	

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) DATE February 2002								
BUD(02 ·	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 4847						
(U) (U) (U) (U) (U)	A. Mission Description Co FY 2003 (\$ in Thousands) \$18,442 This civil \$18,442 Tota \$18,442 Tota B. Project Change Summ Not applicable.	project previously included space unique funding which has been transferred to PE 0602500F, Project ian salaries for the work effort transferred and will be transferred at a later date.	5026. These funds represent the						
(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Fundir Related Activities: PE 0601102F, Defense Res PE 0602114N, Power Proje PE 0602303A, Missile Tech PE 0602805F, Dual Use Sc PE 0603302F, Space and M PE 0603311F, Ballistic Mis PE 0603401F, Advanced Sp This project has been coord	ag Summary (\$ in Thousands) earch Sciences. ction Applied Research. mology. ience and Technology. lissile Launch Technology. sile Technology. sile Technology. pacecraft Technology. inated through the Reliance process to harmonize efforts and eliminate duplication.							
(U)	D. Acquisition Strategy Not Applicable.								
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.								
F	Project 4847	Page 26 of 26 Pages	Exhibit R-2A (PE 0602203F)						

PE TITLE: Aerospace Sensors

	RDT&E BUDGET ITEM J	USTIFIC	CATION	SHEET	(R-2 E)	chibit)		DATE	Februa	ıry 2002
BUDGE 02 - /	T ACTIVITY			PE NUMBE	r and title 4F Aero:	space Se	ensors			
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	65,412	80,847	75,799	80,380	86,316	94,626	96,330	Continuing	TBD
2002	Electronic Component Technology	21,461	20,302	13,184	11,846	12,770	16,725	16,942	Continuing	TBD
2003	EO Sensors & Countermeasures Tech	11,312	14,557	14,663	15,865	15,871	16,325	16,815	Continuing	TBD
4916	Electromagnetic Tech	0	7,298	7,264	7,420	7,507	7,685	7,888	Continuing	TBD
5016	Photonic Component Technology	0	0	2,343	2,767	3,196	2,264	2,273	Continuing	TBD
5017	RF Processing for ISR Sensors	0	0	8,143	6,773	7,988	8,037	7,595	Continuing	TBD
6095	Sensor Fusion Technology	14,165	13,237	12,968	12,385	14,271	16,431	17,097	Continuing	TBD
7622	RF Sensors & Countermeasures Tech	18,474	25,453	17,234	23,324	24,713	27,159	27,720	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	Continuing	TBD
In FY 7	2002 work performed under PE 0602702E Project	4600 move	to this PF	Project 4916	5 Annarent	project ram	s are due or	ly to realign	ment of the	projects This

In FY 2002, work performed under PE 0602702F, Project 4600, moved to this PE, Project 4916. Apparent project ramps are due only to realignment of the projects. This realignment aligned projects with the Air Force Research Laboratory organization. Project realignment did not affect work planned for the overall program element or the budget topline. In FY 2003, space unique tasks in this PE, Projects 2002, 6095, and 7622, will be transferred to PE 0602500F, Projects 5028 and 5029, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

Page 1 of 26 Pages

Exhibit R-2 (PE 0602204F)

	RDT&E BUDGET ITEM JUSTIFIC	CATION SHEET (R-2 Exhib	it)	DATE Febru	ary 2002
BUD(02 •	GET ACTIVITY - Applied Research	PE NUMBER AND TITLE 0602204F Aerospac	e Sensors		,
(U)	A. Mission Description This program develops the technology base for Air Force aerosp providing 'anytime, anywhere' surveillance, reconnaissance, pre- simultaneous advances in: 1) generating, controlling, receiving, 2) electro-optical (EO) aerospace sensor technologies for a varie together with active and passive EO sensors; 4) technologies to technology for reliable, all-weather surveillance, reconnaissance Congress added \$1.2 million for Integration on Flexible Substant Advanced Fourier Transform - Infrared (FT-IR) Gas Analysis.	pace sensors. Advances in aerospace sensor cision targeting, and electronic warfare cap and processing electronic and photonic sign ety of offensive and defensive uses; 3) RF a manage and fuse on-board sensor informati e, and precision strike radio frequency (RF) nces, \$1.8 million for Adverse Weather Ball	rs are required to ir abilities. To achiev nals for radio frequ ntennas and associ on for timely, com sensors and electro listic Imaging and 7	acrease combat effective ve this progress, this pro- ency (RF) sensor aerosp ated electronics for airb prehensive situational a pnic combat systems. N Targeting System, and S	eness by ogram pursues pace applications; oorne surveillance, twareness; and 5) Note: In FY 2002, \$1.0 million for
(U)	<u>B. Budget Activity Justification</u> This program is in Budget Activity 2, Applied Research, since it revolutionary sensor, electronics, and electronic combat technology	t develops and determines the technical feas	sibility and military	y utility of evolutionary	and
(U)	C. Program Change Summary (\$ in Thousands)				
(U) (U) (U)	Previous President's Budget Appropriated Value Adjustments to Appropriated Value	<u>FY 2001</u> 67,024 67,644	<u>FY 2002</u> 84,149 81,149	<u>FY 2003</u> 81,697	<u>Total Cost</u>
(0)	 a. Congressional/General Reductions b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram 	-1,612	-302		
	e. Rescissions	-620			
(U) (U)	Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR	65,412	80,847	-5,898 75,799	TBD
		Page 2 of 26 Pages		Exhibit R-2	(PE 0602204F)
		132			

RDT&E BUDGET ITEM JU	STIFICATION SHEET (R-2 Exhibit)	DATE February 2002
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sens	sors
(U) <u>C. Program Change Summary (\$ in Thousands) Co</u>	ntinued	
(U) <u>Significant Program Changes:</u> In FY 2002, work performed under PE 0602702F, Proje This realignment aligned projects with the Air Force Re element or the budget topline. In FY 2003, space uniqu in conjunction with the Space Commission recommend	ect 4600, moved to this PE, Project 4916. Apparent project research Laboratory organization. Project realignment did not ue tasks in this PE, Projects 2002, 6095, and 7622, will be translation to consolidate all space unique activities.	amps are due only to realignment of the projects. t affect work planned for the overall program nsferred to PE 0602500F, Projects 5028 and 5029,
	Page 3 of 26 Pages	Exhibit R-2 (PE 0602204F)

	RDT&B	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	nry 2002
BUD0 02 ·	GET ACTIVITY - Applied Resear	rch			PE NUMBE	R AND TITLE	space Se	ensors			PROJECT 2002
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2002	Electronic Component	ent Technology	21,461	20,302	13,184	11,846	12,770	16,725	16,942	Continuing	TBD
In F trans (U)	n FY 2003, efforts in photonic component technology will move from this project into this PE, Project 5016. Also in FY 2003, space unique tasks in this project will be ransferred to PE 0602500F, Projects 5028 and 5029, in conjunction with the Space Commission recommendation to consolidate all space unique activities.										
	This project focuses on generating, controlling, receiving, and processing electronic signals for radio frequency (RF) sensor aerospace applications. The enabling technologies developed under this project will be used for intelligence, surveillance, reconnaissance (ISR), electronic warfare (EW), and precision engagement. The technologies developed include: solid state power devices and amplifiers; low noise and signal control components; high-temperature electronics; signal control and distribution, signal processing; multi-function monolithic integrated circuits; high-speed analog-to-digital and digital-to-analog mixed mode integrated circuits; power distribution; multi-chip modules; and high density packaging and interconnect technologies. This project also designs, develops, fabricates, and evaluates techniques for integrating combinations of these electronic component technologies. The project aims to demonstrate significantly improved military sensors of smaller size, lower weight, lower cost, lower power dissipation, higher reliability, and improved performance. The device and component technology developments under this project are military unique; they are based on Air Force and other DoD weapon systems requirements in the areas of radar, communications, EW, navigation, and smart weapons.										
(U) (U)	FY 2001 (\$ in Thousa \$3,313	ands) Developed compact, affordab miniature airborne digital reco ultra-low power (<3.0W) ana portions of this work were pe	le, multi-fur eiver compo log-to-digita rformed in F	nction receiv nents. Desig l converters. Project 6096.	er and phase gned and fab . Demonstra	d array com ricated direc ted and refin	ponents for t digital way ned advance	radar, EW, a veform trans d componen	nd other ISI mitters and i t evaluation	R sensors. I high-resoluti methods. (I	Demonstrated on (10-16 bit), n FY 2000,
(U)	\$4,044	Developed microwave techno operating temperature, high-e carbide transistors for air defe high-power heterojunction bij performed in Project 2000.)	ologies for a fficiency po ense network polar transis	lvanced RF wer amplifie tors for grou	apertures and er to allow di rated advand nd and airbo	d phased arr ispersed plac ced vacuum orne radars a	ay antennas cement of ac electronics c nd EW trans	used in mili- tive arrays. components. mitters. (In	tary ISR sen Demonstrat Conducted FY 2000, pe	sors. Fabric ed S-band (2 a reliability ortions of thi	ated a high -4 GHz) silicon evaluation of s work were
(U)	\$10,018	Developed packaging and inte multi-chip module surface pro	egration tech otective coat	nnologies for ings and miz	high perfor xed analog/d	mance aeros igital microv	pace RF sen wave circuit	sor compon s to improve	ents. Demo	nstrated dev nd lower the	ice and cost of
F	Project 2002			Page	4 of 26 Pag	es			Ex	hibit R-2A	(PE 0602204F)

	RDT&I	DATE February 2002		
вирс 02 -	GET ACTIVITY • Applied Resea	PROJECT 2002		
(U)	A. Mission Descript	on Continued		
(U)	FY 2001 (\$ in Thous	ands) Continued components operating in harsh military environments. Tested advanced packa EW transmitters. (In EX 2000, portions of this work were performed in Project	ging and interconnect process	es for phased array antennas and
(U)	\$489	Developed signal control components and techniques to meet radio frequency (EW), and intelligence, surveillance, and reconnaissance (ISR) sensors. Design improvement in RF loss performance. Developed miniature filters for high per	(RF) loss levels required for function for the second seco	iture radar, electronic warfare phase shifters with a 300% nd EW receivers.
(U)	\$1,597	Developed RF photonics technologies to demonstrate compact, affordable, wice photonic components for high performance digital receivers and signal process 6096.)	le bandwidth, high data rate ac sors. (Prior to FY 2001, this w	erospace sensors. Fabricated ork was performed in Project
(U)	\$2,000	Developed three-dimensional (3-D) interconnects and packaging technologies	for 3-D non-volatile memory.	
(U)	\$21,461	Total		
(U)	FY 2002 (\$ in Thous	unds)		
(U)	\$3,294	Develop compact, affordable, multi-function receiver and phased array composed Gallium Arsenide (GaAs), Indium Phosphide (InP), and silicon-on-insulator R receiver modules. Develop a brassboard low-power (< 1.0W) analog-to-digital package. Complete study and design phase of a multi-mode/multi-function dig study on performing wideband direct digital synthesis from aerospace platform	nents for radar, EW, and other F components for bench-level l converter and deliver for test gital receiver prototype module ns.	ISR sensors. Demonstrate evaluation of radar and EW digital ing in a space-qualified silicon e, and complete a feasibility trade
(U)	\$3,326	Develop microwave technologies for advanced RF apertures and phased array robust components for L-band and X-band transmitters and receivers that opera greater than 60% efficient with no active cooling, provide 20 Watts of output p than 200 degrees Celsius operating temperature.	antennas used in military ISR ate with limited environmentation ower, designed for radiation to	sensors. Develop and demonstrate controls. The components will be olerance to 1 Mrad and greater
(U)	\$4,192	Develop packaging and integration technologies for high performance aerospace in an aerospace 20 GHz transmitter and a Ku-to -X-Band down-converter using membrane to enable an ultra lightweight transmit/receive subarray. Develop r interconnects, chip coatings, and advanced design techniques to enable high de for aerospace applications.	ce RF sensor components. De g low-cost packaging techniqu nixed signal multichip module ensity micro-electro-mechanica	monstrate ten-fold cost reduction es. Develop a novel, flexible es, and evaluate three-dimensional al systems and flexible assemblies
(U)	\$604	Develop signal control components and techniques to meet RF loss levels requ	ired for future radar, electroni	c warfare, and ISR sensors.
Р	Project 2002	Page 5 of 26 Pages		Exhibit R-2A (PE 0602204F)

	RDT&E	DATE February 2002								
вирс 02 -	BET ACTIVITY Applied Resear	PROJECT 2002								
(U)	A. Mission Description	on Continued								
(U)	FY 2002 (\$ in Thousands) Continued Fabricate and characterize micro-electro-mechanical systems phase shifters for 300% improvement in RF loss performance operating over a 3:1									
(U)	\$4,205 Develop RF photonic technologies to demonstrate compact, affordable, wide bandwidth, high data rate aerospace sensors. Develop low-loss, low-voltage broadband modulators for compact digital receiver applications. Design high-performance components for wideband phased array antennas. Investigate the integration of photonic solutions for long time delays with the micro-electro-mechanical phase shifters for short delays to increase handwidth.									
(U)	\$2,502	Develop innovative transmitter and receiver concepts along with the associated component technology altern space-based radio frequency (RF) surveillance sensor system. Design architectures that maximize predicted technology payoffs, and identify long lead-time RF sub-components required for space-based moving target	atives required for an affordable transmitter and receiver indication.							
(U)	\$991	Design and develop Fourier Transform-Infrared spectrometric gas analysis techniques for applications in cor during the vapor phase epitaxial growth of semiconductor films on substrates. These techniques will also be in nanostructure growths for electronic and optical devices, and in the development of new approaches to det agents.	trolling reactant gases generated used to monitor gas concentrations tecting chemical and biological							
(U)	\$1,188	Develop and conduct a proof of concept demonstration of the integration of active aperture components into Integrating these components will enable robust chip placement on flexible phased array subassemblies for recommunications systems.	flexible RF-compatible substrates. adar, electronic warfare, and							
(U)	\$20,302	Total								
(U)	FY 2003 (\$ in Thousa	<u>nds)</u>								
(U)	 \$3,597 Develop compact, affordable, multi-function receiver/exciter and phased array components for communications, Global Positioning System (GPS), radar, electronic warfare (EW), and other intelligence, surveillance, and reconnaissance (ISR) sensors. Test Gallium Arsenide and Indium Phosphide RF components (ADCs, filters, mixers, etc.) inserted into radar and EW digital receiver modules against environment scenarios. Demonstrate a brassboard low-power (< 1.0W), silicon-on-sapphire based analog-to-digital converter and completed ground-level radiation testing in a space-qualified package. Laboratory test a silicon-on-insulator mixed-signal (digital, RF, microwave, etc.) integrated circuit, for reconfigurable signal conversion. 									
(U)	\$2,545	Develop microwave technologies for advanced RF apertures and phased array antennas used in military ISR robust components for L-band and X-band transmitter and receiver channels that operate with limited enviro	sensors. Develop and demonstrate nmental controls and under severe							
Р	roject 2002	Page 6 of 26 Pages	Exhibit R-2A (PE 0602204F)							

	RDT&	DATE February 2002						
BUD 02 ·	GET ACTIVITY - Applied Resear	ch	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT 2002				
(U)	A. Mission Descript	ion Continued						
(U)	FY 2003 (\$ in Thouse	ands) Continued						
(U)	\$3,247	electromagnetic stress. Develop integration and assembly technologies for high membrane based sub-assemblies that enable integrating	h performance aerospace phased array sensors. Demo glow-cost and low-mass transmitter and receiver chan	nstrate X-band, flexible RF nels at the subarray level.				
(U)	 \$2,171 Develop signal control and low-power consumption components and techniques to reduce both power loss and power consumption. These components will be required for future radar, EW, and ISR sensors. Characterize and mature micro-electro-mechanical systems wideband phase shifters for extended switch lifetimes. Reduce the power consumption of low-noise amplifiers while maintaining high linearity over wide bandwidths. 							
(U)	\$1,624	Refine materials and processes for two-dimensional an environment. Verify these inteconnects and component technologies (digital, analog, microwave and millimeter (non-hermetic multi-chip modules) and package-less (b	d three-dimensional device interconnects and compon ts perform on rigid, flexible, and conformal assemblie r wave devices and components). Test interconnects pare-die-chip on board) forms.	ent protection from the es of high density mixed signal and components in both packaged				
(U)	\$13,184	Total						
(U)	<u>B. Project Change S</u> Not Applicable.	ummary						
(U) (U) (U) (U) (U) (U)	 U) C. Other Program Funding Summary (\$ in Thousands) U) Related Activities: U) PE 0602500F, Multi-disciplinary Space Tech. U) PE 0603203F, Advanced Aerospace Sensors. U) PE 0603270F, Electronic Combat Technology. U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication 							
(U)	D. Acquisition Strategy Not Applicable.							
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.							
F	Project 2002	Page	7 of 26 Pages	Exhibit R-2A (PE 0602204F)				

	RDT&	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDGET ACTIVITY PE NUMBER AND TITLE 02 - Applied Research 0602204F Aerospace Sensors											PROJECT 2003
	COST (\$ in Thousands) FY 2001 FY 2002 Actual Estimate					FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2003	EO Sensors & Co	untermeasures Tech	11,312	14,557	14,663	15,865	15,871	16,325	16,815	Continuing	TBD
(U)	U) <u>A. Mission Description</u> This project determines the technical feasibility of advanced electro-optical (EO) aerospace sensor technologies for a variety of offensive and defensive uses. The sensor technologies under development range from the ultraviolet through the infrared (IR) portion of the spectrum. Related efforts include improvements in avionics integration, digital processing, analysis tools, and sensor architectures. One of the project's main goals is to improve EO and related technologies for the detection, tracking, and identification of non-cooperative and difficult targets, such as those obscured by camouflage. This project also develops the passive and active hyperspectral imaging sensors and algorithms needed to enable precision targeting in severe weather. These technologies are critical to future air- and space-based surveillance and targeting. Other project goals include advanced EO threat warning and countermeasures.										
(U)	FY 2001 (\$ in Thou	sands)									
(U)	\$3,497	Developed day/night EO sens altitude and space. Develope field tests on techniques and o	or compone d imaging sp components.	nt technolog pectrometer Assessed p	ties to detect techniques a erformance.	, locate, and nd multispec	identify low etral focal pl	v contrast gro ane array co	ound and aer mponents.	rospace targe Performed la	ts from high boratory and
(U)	\$1,042	Developed technology for not coherent image processing/ex	n-cooperativ	e identificat orithms. Flig	ion of airbor ght demonstr	me and groun ated a multi	nd-based pla function lad	atforms. Des ar.	igned long-	range sensor	s. Tested
(U)	\$891	Developed military-unique of technologies integrated with a	otical transm nilitary-unic	ission comp	onents to en ents.	able informa	tion domina	nce. Demoi	nstrated usef	ful commerci	al-off-the-shelf
(U)	 \$2,356 Developed innovative techniques and components to target difficult objects in degraded atmospheric conditions. Fabricated components for active multispectral imaging. Assessed active imaging systems for their ability to penetrate weather and obscurants. Designed generic modules to improve capabilities of existing systems. Analyzed and demonstrated concepts based on high precision pointing, range gating, and image processing 										
(U)	\$687	Developed countermeasure te imaging missile seekers. (Pri	chnologies a or to FY 200	against IR-g 01, this work	uided missile was conduc	es and EO th ted in Proje	reats. Desig ct 2000.)	gned compor	ents and ref	ïne techniqu	es to defeat
(U)	 \$1,521 Developed aerospace missile and laser warning technologies to accurately cue countermeasures. Developed temporal and spectral tracking algorithms, advancing from two-color to multispectral imaging techniques. Tested advanced sensor hardware. (Prior to FY 2001, this work was conducted in Project 2000.) 										
Р	roject 2003			Page	8 of 26 Pag	es			E>	hibit R-2A	(PE 0602204F)

	RDT&	DATE February 2002									
BUDO 02 -	GET ACTIVITY • Applied Resear	PROJECT 2003									
(U)	A. Mission Descript	on Continued									
(U) (U)	 J) <u>FY 2001 (\$ in Thousands) Continued</u> J) \$1,318 Developed optical transmitter technology capable of sensing multiple target characteristics to provide robust non-cooperative target identification. Fabricated a single imaging and non-imaging transmitter. (In FY 2001, this effort transferred from this PE. Project 2000.) 										
(U)	\$11,312	Total									
(U)	FY 2002 (\$ in Thousa	<u>nds)</u>									
(U)	\$3,080	Develop technology for non-cooperative identification of long-range combat identification (CID) sensors. Test col registration algorithms. Conduct measurements and eval model development, validation, and performance predicts for CID.	Fairborne and ground-based platforms. Conduct gr nerent image processing/extraction algorithms inclu uate advanced 3-D focal planes for CID application ions. Continue analyzing and evaluating multifunct	ound-to-air demonstration of ding three-dimensional (3-D) block . Continue passive hyperspectral ion ladar flight demonstration data							
(U)	\$2,799	Develop optical transmitter technology capable of sensin Continue developing a pulsed vibration/imaging sensing components of a monolithic, solid state coherent ladar are	g multiple target characteristics for robust non-coop system for long-range combat identification. Invest chitecture.	erative target identification. igate and demonstrate critical							
(U)	\$3,549	Develop innovative techniques and components to target altitude active sensors. Test components for active multis obscurants. Design and demonstrate targeting concepts b non-mechanical EO beam steering devices. Investigate c	difficult objects in degraded atmospheric condition spectral imaging. Demonstrate electro-optical (EO) based on high precision pointing, range gating, and i component designs for ladar apertures.	s. Begin utility analysis of high imaging through weather and mage processing. Evaluate							
(U)	\$1,808	Develop countermeasure technologies for use against infit to defeat imaging missile seekers. Continue exploiting a	rared- and EO-guided missiles. Continue to design dvanced infrared missile technology.	components and refine techniques							
(U)	\$1,539	Develop aerospace missile and laser warning technologie algorithms focused on multi-spectral imaging techniques space environment.	es to accurately cue countermeasures. Laboratory te . Evaluate advanced laser warning sensor compone	st temporal and spectral tracking nt hardware for application in a							
(U)	\$1,782	 Investigate the feasibility of designing and fabricating a 3-D Adverse Weather Ballistic Imaging and Targeting System imaging laser radar sensor for the Predator Unmanned Aerial Vehicle. This laser radar would be capable of making one-foot resolution 3-D images of targets and areas of interest through medicate along a sensor. 									
(U)	\$14,557	Total									
Р	Project 2003	Page 9 d	of 26 Pages	Exhibit R-2A (PE 0602204F)							
			139								

	RDT&	DATE February 2002							
BUD0 02 -	GET ACTIVITY - Applied Resear	PE NUMBER AND TITLE Ch 0602204F Aerospace Sensors	PROJECT 2003						
(U)	A. Mission Descript	ion Continued							
(U) (U)	FY 2003 (\$ in Thousands)\$4,571Develop technology for non-cooperative identification of airborne and ground-based platforms. Conduct air-to-air and air-to-ground demonstrations of long-range combat identification (CID) sensors. Test range-resolved coherent image processing and extraction algorithms, including three-dimensional (3-D) block registration algorithms. Conduct long-range experiments using advanced 3-D sensors for CID applications. Continue passive hyperspectral model development, validation, and performance predictions, and assess signature-based data processing performance based on ground demonstration data. Continue flights, analysis, and evaluation of multifunction ladar for								
(U)	\$3,149	Develop optical transmitter technology capable of sensing multiple target characteristics for robust non-coop Develop pulsed vibration sensing system for long range CID. Begin development of flight-capable, multi-fu platform compensation techniques into new architectures. Develop breadboard multi-spectral transmitter, and types of targets.	erative target identification. nction architectures. Integrate ad predict performance for different						
(U)	\$4,346	Develop innovative techniques and components to target difficult objects in degraded atmospheric condition altitude active sensors, including platform trades. Perform tower tests of an active multi-spectral imaging sy through weather and obscurants through flight test of active imaging sensors. Design and demonstrate conception pointing, range gating, and image processing. Develop concepts for airborne application of non-mechanical mitigating aero-optical effects. Investigate concepts for combined radio frequency and electro-optical apertu	s. Continue utility analysis of high stem. Demonstrate imaging pts based on high precision beam steering devices, including tres.						
(U)	\$1,948	Develop countermeasure technologies for use against infrared-guided missiles and electro-optical threats. Corefine techniques to defeat imaging missile seekers. Continue the exploitation of advanced infrared missile techniques to defeat imaging missile seekers.	ontinue to design components and echnology.						
(U)	\$649	Develop aerospace missile and laser warning technologies to accurately cue countermeasures. Laboratory te algorithms focused on multi-spectral imaging techniques. Initiate the testing of an advanced laser warning re-	st temporal and spectral tracking eceiver for application in a space						
(U)	\$14,663	Total							
(U)	B. Project Change S Not Applicable.	ummary							
Р	Project 2003	Page 10 of 26 Pages	Exhibit R-2A (PE 0602204F)						

RDT&E BUDGET ITEM JUSTIFI	DATE February 2002	
BUDGET ACTIVITY 02 - Applied Research	PROJECT 2003	
 (U) <u>C. Other Program Funding Summary (\$ in Thousands)</u> (U) Related Activities: (U) PE 0602500F, Multi-disciplinary Space Tech. (U) PE 0603253F, Advanced Sensor Integration. (U) PE 0602301E, Intelligence System Program. (U) This project has been coordinated through the Reliance proces 	s to harmonize efforts and eliminate duplication.	
(U) <u>D. Acquisition Strategy</u> Not Applicable.		
 (U) <u>E. Schedule Profile</u> (U) Not Applicable. 		
Project 2003	Page 11 of 26 Pages	Exhibit R-2A (PE 0602204F)
	141 UNCLASSIFIED	

	RDT8	E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDO 02 -	GET ACTIVITY • Applied Resea	arch	PE NUMBE	r and title 4F Aeros	space Se	ensors			PROJECT 4916		
	COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4916	Electromagnetic ⁻	Tech	0	7,298	7,264	7,420	7,507	7,685	7,888	Continuing	TBD
In F	Y 2002, this work tra	nsfers to this project from PE 060)2702F, Proj	ect 4600.				1			
(U)	J) <u>A. Mission Description</u> This project develops technology for sensor systems that cover the electromagnetic spectrumfrom radio frequency (RF) to optical. It develops RF antennas and associated electronics for airborne and space-based surveillance. It also investigates RF scattering phenomenology for applications in ground and air moving target indicators in extremely cluttered environments. The project develops active and passive electro-optical sensors for use in concert with RF sensors. It develops low-cost active sensors that use reliable high-performance solid state components for target detection and identification and missile threat warning. The project also develops passive multi-dimensional sensors to improve battlefield awareness and identify threats at long-range.										
(U)	FY 2001 (\$ in Thou	isands)									
(U)	\$0 \$0	Effort conducted in PE 06027	02F, Projec	t 4600.							
(0)	φ υ ΕV 2002 (¢ in Theor	rotai									
(U) (U)	<u>FY 2002 (\$ in 1 nou</u> \$1.792	Develop experimental and the	eoretical tecl	nniques for t	he character	zation of ele	ectromagnet	ic scattering	from targets	s and terrain	as applied to the
(U)	\$1,941	detection of difficult airborne Design and develop antennas Develop new algorithms for o	and ground for airborne ligital beam-	-based target and space-b	ts in clutter f based surveil ti-beam ante	rom airborn lance. Desig nnas. Devel	e or space-b gn, analyze, lop antenna	ased surveill and build ad	ance platfor vanced large	ms. e lightweight ctronics.	antenna arrays.
(U)	\$1,672	 \$1,672 Design and develop next generation electro-optical techniques and advanced components for use in detection and identification of concealed targets. Design and fabricate multifunction sensor arrays and innovative materials and device technologies for optical beamsteering. Design and develop active components and advanced integration techniques for autonomous ladar-guided munitions and other imaging applications. 									
(U)	\$1,893	Develop hardware and softwa Establish the viability of tomo spectral target identification t characterization of explosions	ore for passiv ographic hypols. Evalues and missile	ve multi-dim perspectral se ate the applie launches, a	ensional sen ensing techn cability of th nd to the dev	sing in the the iques for mission and new velopment of	hermal infra ssions that h tomographi f techniques	red spectral ave not beer ic hyperspec for real-time	wavelength able to cap tral sensor c bomb dama	range at high italize on the oncepts to th age assessme	frame rates. power of e ent.
Р	roject 4916			Page	12 of 26 Pag	jes			E>	hibit R-2A	PE 0602204F)

	RDT&I	DATE February 2002						
вирс 02 -	GET ACTIVITY	PROJECT 4916						
(U)	A. Mission Descript	on Continued						
(U) (U)	<u>FY 2002 (\$ in Thous</u> \$7,298	ands) Continued Total						
(U) (U)	<u>FY 2003 (\$ in Thous</u> \$1,933	unds) Investigate detecting difficult airborne and ground-based targets in clutter from airborne or space-bas models and experimental techniques for characterizing radio frequency scatter from targets, ground c	sed surveillance platforms. Develop					
(U)	\$1,850	Design and develop antennas for airborne and space-based surveillance. Design, analyze, and build a Develop new algorithms for digital beam forming and limited-scan phased array antennas. Develop l	advanced large lightweight antenna arrays. high-speed electronics antenna front end					
(U)	 applications and micro-electro-mechanical systems technology for delay line switching in phased arrays. \$1,681 besign and develop new electro-optical techniques and components for detecting and identifying concealed targets. Design and fabricate multifunction sensor arrays and the associated materials and device technologies for optical beam steering. Design and develop active components and integration techniques for autonomous three dimensional ladar-guided munitions and other imaging applications. Develop 							
(U)	\$1,800	Develop hardware and software for passive multi-dimensional sensing in the thermal infrared spectra Establish viability of tomographic hyperspectral sensing techniques for aerospace applications. Dem hyperspectral sensor concepts to characterizing explosions and missile launches, and to developing te assessment.	al wavelength range at high frame rates. nonstrate the applicability of tomographic echniques for real-time bomb-damage					
(U)	\$7,264	Total						
(U)	<u>B. Project Change S</u> Not Applicable.	ummary						
(U) (U) (U) (U) (U)	 J. <u>C. Other Program Funding Summary (\$ in Thousands)</u> J. Related Activities: J. PE 0602500F, Multi-disciplinary Space Tech. J. PE 0602702F, Command Control and Communications J. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. 							
(U)	D. Acquisition Strate Not Applicable.	<u>ey</u>						
Р	Project 4916	Page 13 of 26 Pages	Exhibit R-2A (PE 0602204F)					
		1/2						

RDT&E BUDGET ITEM JU	DATE February 2002		
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT 4916	
 (U) <u>E. Schedule Profile</u> (U) Not Applicable. 			
Project 4916	Page 14 of 26 Pages	Exhibit R-2A (PE 0602204F)	

	RDT&E BUDGET ITEM J	JSTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDGET ACTIVITY PE NUMBER AND TITLE 02 - Applied Research 0602204F Aerospace Sensors									PROJECT 5016	
	COST (\$ in Thousands)FY 2001 ActualFY 2002 EstimateFY 2003 EstimateFY 2004 						FY 2007 Estimate	Cost to Complete	Total Cost	
5016	Photonic Component Technology	0	0	2,343	2,767	3,196	2,264	2,273	Continuing	TBD
In F` (U)	FY 2003, photonic component technology work previously performed in this PE, Project 2002, will transfer to this project.) A. Mission Description This project focuses on designing and developing methods to generate, control, receive, transmit, and process opto-electronic (mixed) signals for radio frequency (RF) sensor aerospace applications. Enabling technologies developed under this project for intelligence, surveillance, reconnaissance (ISR), electronic warfare (EW), and precision engagement sensors include: low noise, aerospace environmentally-qualified signal control components (e.g., electro-optic switches, micro-opto-electronic mixed signals (MOEMS); electro-optic components for RF links; photonic signal control, distribution, and signal processing; multi-function, aerospace-qualified, opto-electronic integrated circuits; wide band photonic-based high-speed electro-optic analog-to-digital and digital-to-analog converters; and opto-electronic intraconnects and interconnects. This project designs, develops, fabricates, and evaluates techniques for integrating various combinations of photonic and electronic technologies. The main purpose is to demonstrate significantly improved military sensors of smaller size, lower weight, lower cost, lower prime power, higher reliability, and improved performance as compared to current systems. The device, component, and subsystem technology developments under this project are military unique and based on Air Force and other DoD weapon systems requirements in the areas of radar, sensors, communications, EW, navigation, and smart									
(U) (U) (U)	FY 2001 (\$ in Thousands)\$0No Activity\$0Total									
(U) (U) (U)	FY 2002 (\$ in Thousands)\$0No Activity\$0Total									
(U) (U) (U) (U)	FY 2003 (\$ in Thousands) \$1,650 Develop high performance integrated photonic technology link, interconnect, and switching components and subsystems for wideband RF phased array antenna beamforming and control, and for high data rate aerospace sensors and communication systems. \$693 Develop ultrafast, wideband photonic analog-to-digital mixed signal conversion component technology. \$2,343 Total									
P	Project 5016		Page	15 of 26 Pag	ges			Ex	hibit R-2A	(PE 0602204F)

	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 2002									
BUD 02	GET ACTIVITY • Applied Research	PROJECT 5016									
(U)	B. Project Change Summary Not Applicable.										
(U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602500F, Multi-disciplinary Space Tech. PE 0603203F, Advanced Aerospace Sensors. PE 0603270F, Electronic Combat Technology. This project has been coordinated through the Reliance process to harmon	ize efforts and eliminate duplication.									
(U)	D. Acquisition Strategy Not Applicable.										
(U) (U)	E. Schedule Profile Not Applicable.										
F	Project 5016 Pa	ge 16 of 26 Pages	Exhibit R-2A (PE 0602204F)								
	146										
Γ	RDT&E	E BUDGET ITEM JU	STIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ary 2002
---------------------	---	---------------------------------	-------------------	---------------------	---------------------	-------------------------	---------------------	---------------------	---------------------	---------------------	------------------
виро 02 -	GET ACTIVITY • Applied Resear	ch			PE NUMBE	r and title 4F Aero:	space Se	ensors			PROJECT 5017
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5017	RF Processing for I	SR Sensors	0	0	8,143	6,773	7,988	8,037	7,595	Continuing	TBD
In F this p	Y 2003, efforts in radio project.	frequency processing for intell	igence, surv	eillance, and	l reconnaissa	ance sensors	previously j	performed in	this PE, Pro	oject 7622, v	vill transfer to
(U)) <u>A. Mission Description</u> This project develops and assesses radar technology for affordable, reliable, all weather aerospace surveillance and reconnaissance systems. Emphasis is on detecting and tracking surface and airborne targets that have difficult to detect signatures due to reduced cross sections, concealment and camouflage measures, severe clutter, or heavy jamming. Techniques exploited include the use of multiple radio frequency phenomenologies, multi-dimensional adaptive processing, advanced waveforms, and knowledge-aided processing techniques.										
(U) (U) (U)	<u>FY 2001 (\$ in Thouse</u> \$0 \$0	ands) No Activity Total									
(U) (U) (U)	<u>FY 2002 (\$ in Thouse</u> \$0 \$0	ands) No Activity Total									
(U) (U)	 <u>FY 2003 (\$ in Thousands)</u> \$1,572 Investigate techniques for implementing distributed airborne sensor systems to increase sensitivity and improve location accuracy. These techniques include sparse arrays with maneuvering platforms and improved location accuracy using interfermetric methods combined with knowledge-based responsive mode selections. 										
(U)	\$2,098 Investigate techniques for multi-intelligence data acquisition from a single platform. Investigate common waveform techniques, knowledge-based scheduling, and advanced target detection for both unconcealed and concealed targets. Determine the electromagnetic compatibility issues associated with simultaneously hosting and operating multiple radars, electronic support measure receivers, integrated communications, and electronic attack components on a single platform. Investigate methods to mitigate unintentional interference sources to multi-intelligence platforms from the ground and in the air, such as commercial broadcast assets, civilian radar assets, and commercial communications systems.										
Р	roject 5017			Page	17 of 26 Pag	ges			Ex	hibit R-2A	(PE 0602204F)
	147										

	RDT&E	BUDGET ITEM JUSTIFICATION S	HEET (R-2A Exhibit)	DATE February 2002				
вирс 02 -	SET ACTIVITY Applied Resear	ch	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT 5017				
(U)	A. Mission Descripti	on Continued						
(U) (U)	<u>FY 2003 (\$ in Thousa</u> \$3,940	nds) Continued Develop multi-mission aerospace microwave processin targets, and stationary targets in severe clutter and jami operational modes, including air and ground target dete emission detection. Study advanced waveforms for acl interference rejection, self protection, and target identif codings. Develop knowledge-aided radar signal proces moving target indication sensors.	ng algorithms to detect and locate advanced cruise mission ming environments. Study multi-mission adaptive race ection, ground target imaging, electronic protection, and hieving transmitter adaptivity and simultaneous multi- fication by exploiting diversities in frequencies, delay ssing techniques for improved detection and false alar	ssiles, slowly moving ground lar algorithms to support various nd passive radio frequency -mode operation to improve s, polarizations, modulations, and m control performance in ground				
(U) (U)	Study and analyze technology for detecting and precisely locating concealed targets using standoff aerospace platforms. Initiate investigating emerging adaptive processing techniques for knowledge-aided multi-mission processing and resource management. Initiate the study of adaptive processing techniques for multi-mission conformal arrays. Initiate the study of wideband and polarization adaptive processing techniques for multi-function radar.							
(U)	<u>B. Project Change S</u> Not Applicable.	ummary						
(U) (U) (U) (U) (U) (U)	C. Other Program F Related Activities: PE 0602500F, Multi-c PE 0603203F, Advance PE 0603270F, Electro This project has been	unding Summary (\$ in Thousands) lisciplinary Space Tech. ced Aerospace Sensors. nic Combat Technology. coordinated through the Reliance process to harmonize e	efforts and eliminate duplication.					
(U)	D. Acquisition Strate Not Applicable.	gy						
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.							
Р	roject 5017	Page 1	8 of 26 Pages	Exhibit R-2A (PE 0602204F)				

	RDT8	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUD 02	GET ACTIVITY - Applied Resea	arch			PE NUMBE 060220	R AND TITLE	space Se	ensors			PROJECT 6095
	COST (\$) in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
6095	Sensor Fusion Te	echnology	14,165	13,237	12,968	12,385	14,271	16,431	17,097	Continuing	TBD
In F all sj	Y 2003, space unique pace unique activities	tasks in this project will be trans.	ferred to PE	0602500F,	Project 5029	, in conjunc	tion with the	Space Com	mission reco	ommendation	n to consolidate
(U)) <u>A. Mission Description</u> This project develops the technologies required to perform management and fusion of on-board sensor information for timely, comprehensive situational awareness, automatic target recognition (ATR), integrated fire control, and bomb damage assessment. This project determines the feasibility of technologies and concepts for fire control that help to precisely locate, identify, and target airborne and surface targets. The project emphasizes finding reduced signature targets and targets of opportunity. It will enable new covert tactics for successful air-to-air and air-to-surface strikes.										
(U)	FY 2001 (\$ in Thou	isands)									
(U)	\$5,720	Developed, evaluated, and de a live-feed to ground station e	monstrated a emulation to	single and m evaluate rea	ulti-sensor l ıl-time infori	ethality algo nation-into-1	rithms to dra the-cockpit t	amatically ir argeting sch	nprove air co emes, and to	ombat capab o optimize ad	ility. Performed laptive resource
(U)	\$3,119	allocation methods. Completed demonstration of real-time, on-board ATR and information fusion using live threat emitter data. Developed, evaluated, and demonstrated single and multi-sensor radar target signature models to support ATR in strike operations. Transitioned the ground target signature database to an operational air-to-ground ATR system. Developed physics-based dynamic complex synthetic aperture radar scene simulation capability using advanced modeling and simulation techniques. Developed innovative target recognition techniques using advanced scattering phenomenology analysis. Transitioned advanced phenomenology-based target recognition									
(U)	\$1,257	Developed, evaluated, and demonstrated feasibility of multi-sensor ATR algorithms for on- and off-board sensor-to-shooter image and data fusion to rapidly attack time-critical targets. Developed full, collaborative sensor-to-shooter algorithm environment utilizing the most									
(U)	\$134	Developed sensors to provide jamming environments. Deve frequency environments. Ass GPS antenna, and devised tec receivers to simultaneously has	e precise time eloped Glob sessed the ac chniques to e andle strong	e, position, a al Positionin lvantages for xploit this c signals fron	and velocity ag System (C r signal track apability for n nearby diff	measuremen iPS) specific ting of colloo navigation a erential refe	ts to enable jamming m cating an ine and strike. I rence source	multiple-pla itigation tec ertial measur Designed and es and the we	tform, senso hniques for ement unit v l implemente eak signals f	or-to-shooter operation in with the phas ed methods t rom GPS sat	operations in hostile radio e center of a o enable GPS ellites to
F	Project 6095			Page	19 of 26 Pag	ges			E>	hibit R-2A	(PE 0602204F)

	RDT&	DATE February 2002							
BUDO 02 -	GET ACTIVITY	ch	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT 6095					
(U)	A. Mission Descript	on Continued							
(U)	<u>FY 2001 (\$ in Thous</u>	nds) Continued							
(U)	 \$3,935 Beveloped and demonstrated enabling automatic target recognition (ATR) technologies for future intelligence, surveillance, and reconnaissance (ISR) applications. Evaluated physics-based and adaptive learning techniques to reduce cost and increase capabilities of follow-on ISR systems. Using ground-based technology demonstrations and hardware-in-the-loop simulations, continued developing high import technologies are the shifted a large many termstice and etters are highlight. 								
(U)	\$14,165	Total	ingli antitudo, fong range targeting and attack capaoin						
(U)	FY 2002 (\$ in Thousa	nds)							
(U)	\$1,954 Develop and evaluate single and multi-sensor ATR lethality algorithms to dramatically improve capability to rapidly find, track, and target time critical mobile targets. Perform laboratory demonstration of adaptive resource allocation methods for ATR. On embedded high-performance computing systems, develop real-time ATR algorithms for time-critical targets. Develop and evaluate algorithms and concepts for detecting and torgets under trace.								
(U)	 \$2,547 Develop and evaluate single and multi-sensor radar target signature models to support ATR in strike operations. Develop target signature models for multi-sensor fusion of synthetic aperture radar, electro-optical multispectral systems, and signals intelligence in reconnaissance ground stations. Sensor fusion will provide the ability to maintain tracks of vehicle groupings through multiple platforms and missions with a big head helitity of datastices and helitity and head here there 10% followed approximate. 								
(U)	\$1,788	Develop precision time, position, and velocity sensors sensor-to-shooter operations. Continue development of hostile radio frequency environments.	capable of operating in jamming environments enablin of Global Positioning System specific jamming mitigat	ng multiple platform ion techniques for operation in					
(U)	\$5,039	Develop and demonstrate enabling ATR technologies physics-based and adaptive learning techniques.	for intelligence, surveillance, and reconnaissance appl	cations. Continue evaluating					
(U)	\$1,909	Develop ATR and Sensor Fusion performance assessr	nent technology. Conduct ATR performance evaluation	on theory research.					
(U)	\$13,237	Total							
Р	roject 6095	Page	20 of 26 Pages	Exhibit R-2A (PE 0602204F)					
			150						

BUDGET ACTIVITY PE NUMBER AND TITLE PRO. 02 - Applied Research 0602204F Aerospace Sensors 609 (U) A. Mission Description Continued 609 (U) FY 2003 (\$ in Thousands) 609 (U) \$3,976 Continue integrating, evaluating, and demonstrating single and multi-sensor ATR and sensor fusion algorithms for rapidly finding, trackin and targeting mobile targets. Continue integrating real-time ATR algorithms, for time-critical targets, on embedded high-performance computing systems. Complete laboratory demonstration of adaptive resource allocation methods. Continue integrating and evaluating algorithms and concepts for detecting and targeting targets under trees. Complete developing single sensor ATR performance assessment technology, and multi-sensor and sensor fusion assessment technology. Continue ATR performance evaluation theory research. Complete first single sensor automatic target recognition (ATR) performance prediction model. (U) \$3,853 Develop, evaluate, and demonstrate target signature models to support ATR and sensor fusion algorithm development and testing for reconnaissance and strike mission applications. Develop target signature models for signature exploitation of synthetic aperture radar, electro-optical multispectral systems, and signals intelligence sensors. Demonstrate the ability to generate synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Develop modeling and simulation tools that can estimate warfighter effectiveness enhancements due to inserting ATR and sensor fusion aids intot the support automatic recognition of target								
 (U) <u>A. Mission Description Continued</u> (U) <u>FY 2003 (\$ in Thousands)</u> (U) \$3,976 Continue integrating, evaluating, and demonstrating single and multi-sensor ATR and sensor fusion algorithms for rapidly finding, trackin and targeting mobile targets. Continue integrating real-time ATR algorithms, for time-critical targets, on embedded high-performance computing systems. Complete laboratory demonstration of adaptive resource allocation methods. Continue integrating and evaluating algorithms and concepts for detecting and targeting targets under trees. Complete developing single sensor ATR performance assessment technology, and multi-sensor and sensor fusion assessment technology. Continue ATR performance evaluation theory research. Complete first single sensor automatic target recognition (ATR) performance prediction model. (U) \$3,853 Develop, evaluate, and demonstrate target signature models to support ATR and sensor fusion algorithm development and testing for reconnaissance and strike mission applications. Develop target signature models for signature exploitation of synthetic aperture radar, electro-optical multispectral systems, and signals intelligence sensors. Demonstrate the ability to generate synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Develop modeling and simulation tools that can estimate warfighter effectiveness enhancements due to inserting ATR and sensor fusion aids into the sensor fusion aids	JECT)5							
 (U) <u>FY 2003 (\$ in Thousands</u>) (U) \$3,976 Continue integrating, evaluating, and demonstrating single and multi-sensor ATR and sensor fusion algorithms for rapidly finding, trackin and targeting mobile targets. Continue integrating real-time ATR algorithms, for time-critical targets, on embedded high-performance computing systems. Complete laboratory demonstration of adaptive resource allocation methods. Continue integrating and evaluating algorithms and concepts for detecting and targeting targets under trees. Complete developing single sensor ATR performance assessment technology, and multi-sensor and sensor fusion assessment technology. Continue ATR performance evaluation theory research. Complete first single sensor automatic target recognition (ATR) performance prediction model. (U) \$3,853 Develop, evaluate, and demonstrate target signature models to support ATR and sensor fusion algorithm development and testing for reconnaissance and strike mission applications. Develop target signature models for signature exploitation of synthetic aperture radar, electro-optical multispectral systems, and signals intelligence sensors. Demonstrate the ability to generate synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Develop modeling and simulation tools that can estimate warfighter effectiveness enhancements due to inserting ATR and sensor fusion aids into the sensor fusion algorithm development and sensor fusion aids into the sensor and sensor fusion aids into the sensor sensors. 								
(U) \$3,853 Develop, evaluate, and demonstrate target signature models to support ATR and sensor fusion algorithm development and testing for reconnaissance and strike mission applications. Develop target signature models for signature exploitation of synthetic aperture radar, electro-optical multispectral systems, and signals intelligence sensors. Demonstrate the ability to generate synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Develop modeling and simulation tools that can estimate warfighter effectiveness enhancements due to inserting ATR and sensor fusion aids into the	ıg, e the							
reconnaissance and strike components of the time-critical targeting kill chain.	\$3,853 Develop, evaluate, and demonstrate target signature models to support ATR and sensor fusion algorithm development and testing for reconnaissance and strike mission applications. Develop target signature models for signature exploitation of synthetic aperture radar, electro-optical multispectral systems, and signals intelligence sensors. Demonstrate the ability to generate synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Develop modeling and simulation tools that can estimate warfighter effectiveness enhancements due to inserting ATR and sensor fusion aids into the							
(U) \$4,508 Develop and demonstrate enabling ATR, sensor management, and sensor fusion technologies for target detection, tracking, and identification intelligence, surveillance, and reconnaissance (ISR) and combat identification (CID) applications. Complete the evaluation of adaptive learning techniques for target identification. Initiate laboratory demonstration of adaptive sensor management algorithms for target detection tracking, and ID. Continue evaluation of physics-based techniques for target detection and identification for ISR and CID applications.	ion in ion,							
 (U) \$631 (U) \$631 Develop precision time, position, and velocity sensors capable of operating in jamming environments. These sensors will enable multiple platform sensor to shooter operations. Continue development of Global Positioning System specific jamming mitigation techniques for operation in hostile radio frequency environments with emphasis on synergistically integrating anti-jam technologies. Develop virtual flig test technology for improved assessment of reference sensors. 	ght							
(U) \$12,968 Total								
(U) <u>B. Project Change Summary</u> Not Applicable.								
Project 6095 Page 21 of 26 Pages Exhibit R-2A (PE 06022	204F)							

RDT&E BUDGET ITEM JUSTI	DATE February 2002	
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT 6095
 (U) <u>C. Other Program Funding Summary (\$ in Thousands)</u> (U) Related Activities: (U) PE 0602500F, Multi-disciplinary Space Tech. (U) PE 0603203F, Advanced Aerospace Sensors. (U) PE 0602602F, Conventional Munitions. (U) PE 0603270F, Electronic Combat Technology. (U) PE 0603226E, Experimental Evaluation of Major Innovative (U) PE 0603762E, Sensor and Guidance Technology. (U) This project has been coordinated through the Reliance proceed. 	ve Technologies.	
(U) <u>D. Acquisition Strategy</u> Not Applicable.		
 (U) <u>E. Schedule Profile</u> (U) Not Applicable. 		
Project 6095	Page 22 of 26 Pages	Exhibit R-2A (PE 0602204F)
	152	

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)									Februa	ary 2002
виро 02 -	GET ACTIVITY • Applied Resea	rch			PE NUMBE	R AND TITLE	space Se	ensors			PROJECT 7622
	COST (\$ in Thousands)FY 2001 ActualFY 2002 EstimateFY 2003 EstimateFY 2004 EstimateFY 2005 EstimateFY 2006 Estimate							FY 2007 Estimate	Cost to Complete	Total Cost	
7622	RF Sensors & Cou	intermeasures Tech	18,474	25,453	17,234	23,324	24,713	27,159	27,720	Continuing	TBD
In F Also cons	a FY 2003, efforts in radio frequency (RF) processing for intelligence, surveillance, and reconnaissance (ISR) sensors will transfer from this project to this PE, Project 5017. Also in FY 2003, space unique tasks in this project will be transferred to PE 0602500F, Project 5029, in conjunction with the Space Commission recommendation to onsolidate all space unique activities.										
(U)	D A. Mission Description This project develops and assesses RF sensing concepts for aerospace applications through modeling and simulation. This project also develops and evaluates technology for fire control radar, electronic combat (EC), and integrated radar and EC systems. It emphasizes the detecting and tracking of surface and airborne targets with RF signatures that are difficult to detect due to reduced radar cross sections, concealment and camouflage measures, severe clutter, or heavy jamming. This project also develops the RF warning and countermeasure technology for advanced EC applications. Specifically, it develops techniques and technologies to detect and counter the links and sensors of threat air defense systems and hostile command and control networks. The project also exploits emerging technologies and components to provide increased capability for offensive and defensive RF sensors, including radar warning, RE EC, and electronic intelligence applications.										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$4,988	ands) Developed aerospace microw fidelity analytical tools for ev indication, and synthetic aper advanced surveillance technic	vave sensor t valuating and ture radar m	echnologies l predicting t odes. Cond	for detecting the performa ucted airborn	g, locating, a nce of integ ne radar data	and engaging rated air moves a collection.	g airborne an ving target in Performed l	d ground tar ndication, gr aboratory ar 2702E Proje	gets. Develor ound moving nalysis for ap	oped high g target pplication of
(U)	\$4,451	advanced surveillance techniques. (This effort incorporated work previously performed under PE 0602/02F, Project 4506.) Developed aerospace microwave processing algorithms for detecting and locating advanced cruise missiles and slow airborne targets, as well as stationary and moving ground targets in severe clutter and jamming environments. Analyzed individual algorithms for improved air and ground moving target indication algorithm performance. Developed adaptive processing techniques that incorporate knowledge-based approaches									
(U)	\$1,127	Developed technology for de and targeting algorithms, dev control centers.	tecting and a ising technic	ttacking cor ques to preve	acealed targe ent discovery	ts. Evaluat by the ener	ed innovativ ny, and asse	e foliage- ar ssing potent	nd ground-pe	enetrating rac ting buried c	lar waveforms ommand and
(U)	\$3,008	Develop affordable radio free missile, and command and co	quency jamm ontrol system	ning technolo ns. Evaluate	ogy and conc ability to de	cepts that endetect covert/	hance aerosp featureless w	oace vehicle vaveforms.	survivability Test optimiz	y by degradin ed deceptior	ng enemy radar, a countermeasure
Р	roject 7622			Page	23 of 26 Pag	ges			E>	hibit R-2A	(PE 0602204F)

	RDT&E	DATE February 2002							
BUDO 02 -	GET ACTIVITY • Applied Resear	ch PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT 7622						
(U)	A. Mission Descripti	on Continued							
(U)	FY 2001 (\$ in Thousa	ands) Continued							
(U)	 \$3,708 \$3,708 bevelop technology for generic software modules to enable low-cost block upgrades to electronic warfare receivers. Design threat identification software modules for next-generation threat warning receivers. (Prior to FY 2001, this work was conducted in this PE, Project 2000.) 								
(U)	 \$1,192 Developed affordable antenna technology for use in operational and future aerospace platform electronic receivers and apertures. Demonstrated, in the laboratory, an integrated ensemble of low-frequency direction-finding antennas. Developed highly precise, wideband, interferometric multimode direction-finding antennas. Demonstrated a micro-electro-mechanical phase shifter controlled array. Demonstrated design tools to predict antenna performance. (Prior to FY 2001, this work was conducted in this PE, Project 2000.) 								
(U)	\$18,474	Total							
(U)	FY 2002 (\$ in Thousa	ands)							
(U)	\$2,199	Develop aerospace microwave sensor technologies for detecting, locating, and engaging airborne and ground target and clutter phenomenology data collections used to evaluate, validate, and improve engineering tools surveillance, and reconnaissance, and multi-intelligence sensor concept studies and system analyses. Demor in-flight experiments and simulations.	l targets. Conduct airborne radar supporting intelligence, astrate sensor performance through						
(U)	 \$3,551 \$3,551 Develop aerospace microwave processing algorithms for detecting and locating advanced cruise missiles and slow airborne targets, as well as stationary and moving ground targets in severe clutter and jamming environments. Develop multi-mission adaptive radar algorithms to support various operational modes including air and ground target detection, ground target imaging, electronic protection, and passive radio frequency (RF) emission detection. Develop advanced waveforms to achieve transmit adaptivity and simultaneous multi-mode operation. Improve interference rejection, self-protection, and target identification by exploiting diversity in frequency, delay, polarization, modulation, and provint methods. 								
(U)	\$1,276	Develop technology for detecting and precisely locating concealed targets using standoff aerospace platform technology for airborne ground-penetrating radar. Develop and evaluate signal processing algorithms for im performance in foliage-penetrating radar.	s. Develop and evaluate proving detection and false alarm						
(U)	\$1,735	Develop affordable RF jamming technology and concepts that enhance aerospace vehicle survivability by de command and control systems. Develop multifunction electronic warfare (EW) technique waveforms. Eval threats. Develop optimized EW techniques to degrade modern radar, communication, and missile threat systems.	grading enemy radar, missile, and uate exploitations of advanced RF tems.						
Р	Project 7622	Page 24 of 26 Pages	Exhibit R-2A (PE 0602204F)						

	RDT&	DATE February 2002							
виро 02 -	GET ACTIVITY • Applied Resear	The PE NUMBER AND TITLE OG02204F Aerospace Sensors	PROJECT 7622						
(U)	A. Mission Descript	ion Continued							
(U)	FY 2002 (\$ in Thousa	ands) Continued							
(U)	\$2,797 Develop technology to enable low-cost upgrades to RF signal receivers. Model threat identification algorithms for next-generation threat warning receivers. Evaluate state-of-the-art digital receiver subsystems. Design advanced very-high frequency receiver improvements for detecting targets under trees. Design novel RF photonic analog-to-digital converter circuitry for order-of-magnitude gains in performance accuracy versus current state-of-the-art.								
(U)	\$3,816 Develop affordable antenna technology for use in operational and future aerospace platform electronic receivers and apertures. Evaluate wideband, high precision, interferometric, multimode, direction-finding antennas in the laboratory. Develop design tools to predict antenna performance installed on host platform models. Develop robust ultra wideband front and electronics to handle large signals.								
(U)	 \$2,790 Develop and validate, via a global infosphere experiment, the radar architectures, aperture technology, and signal processing to support a space-based moving target indication sensor. Use the collaborative engineering environment to model and assess radio frequency (RF) architectures and signal processing techniques. Analyze the utility of a space-based sensor architecture. 								
(U)	 \$1,983 Design and validate multi-intelligence sensor technologies for total battlefield awareness. Evaluate single platform technologies for common waveform utilization, knowledge-based function scheduling, and superior difficult target detection for both in-the-clear and concealed targets. Develop and evaluate hybrid sensor systems, including space/air/ground combinations delivering improved location accuracies and tracking attratexies. 								
(U)	\$5,306	Develop and analyze concepts for a multi-mission unmanned aerial vehicle based sensor suite capable of det targets and both exposed and concealed ground targets. Determine enabling technologies required for full ta	ecting and tracking advanced aerial rget surveillance capability.						
(U)	\$25,453	Total							
(U)	FY 2003 (\$ in Thousa	ands)							
(U)	\$6,956	Develop affordable RF jamming technology and concepts that enhance aerospace vehicle survivability by de command and control systems. Develop multifunction electronic warfare (EW) technique waveforms. Cont against new, advanced RF threats. Develop optimized EW techniques to degrade modern radar, communica Initiate phase calibration development.	grading enemy radar, missile, and inue exploitation evaluations tion, and missile threat systems.						
(U)	\$5,357	Develop technology to enable affordable upgrades to RF signal receivers. Model threat identification algorith warning receivers. Evaluate state-of-the-art radar and EW digital receiver subsystems with Gallium Arsenid components (ADCs, filters, mixers, etc.) for laboratory environment scenario testing. Design advanced very improvements for detecting targets under trees.	hms for next generation threat le and Indium Phosphide RF high frequency receiver						
Р	Project 7622	Page 25 of 26 Pages	Exhibit R-2A (PE 0602204F)						

	RDT&E B	UDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002						
BUDO 02 -	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT 7622						
(U)	A. Mission Description	Continued							
(U) (U)	 FY 2003 (\$ in Thousands) Continued \$4,042 Develop robust, ultra wide bandwidth antenna technology for use in operational and future aerospace platform electronic apertures. Demonstrate prototype wideband, high precision interferometric multimode direction finding antennas. Develop design tools to predict antenna performance installed on host platform models. Demonstrate components and techniques that increase fivefold the signal handling capability of an aperture. 								
(U)	\$879 De em	evelop and evaluate innovative multi-function RF sensing concepts for aerospace applications through momphasis on system engineering.	deling and simulation with an						
(U) (U)	B. Project Change Sumi Not Applicable.	nary							
(U) (U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Fund Related Activities: PE 0602500F, Multi-disci PE 0603203F, Advanced PE 0603253F, Advanced PE 0602782A, Command PE 0602232N, Navy C3 T PE 0603792N, Advanced This project has been coord	ing Summary (\$ in Thousands) plinary Space Tech. Aerospace Sensors. Avionics Integration. , Control, Communications Technology. Cechnology. Technology Transition. rdinated through the Reliance process to harmonize efforts and eliminate duplication.							
(U) (U) (U)	D. Acquisition Strategy Not Applicable. E. Schedule Profile Not Applicable.								
P	roject 7622	Page 26 of 26 Pages	Exhibit R-2A (PE 0602204F)						

	RDT&E BUDGET ITEM J	DATE	DATE February 2002							
budge 02 - A	T ACTIVITY Applied Research			PE NUMBE 060250	R AND TITLE	FI-DISCIP	LINARY	SPACE	ТЕСН	
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	0	0	53,592	70,020	73,748	68,442	73,070	Continuing	TBD
5023	Laser & Imaging Space Tech	0	0	1,273	1,083	1,012	420	398	Continuing	TBD
5024	Human Centered Applied Space Tech	0	0	496	693	869	0	0	Continuing	TBD
5025	Space Materials Development	0	0	18,608	20,449	23,888	24,144	24,676	Continuing	TBD
5026	Rocket Propulsion Component Tech	0	0	19,612	31,048	32,543	33,206	33,708	Continuing	TBD
5027	High Speed Airbreathing Prop Tech	0	0	4,238	4,668	4,904	5,094	5,210	Continuing	TBD
5028	Space Sensors, Photonics & RF Proc	0	0	1,025	1,602	2,064	1,871	4,491	Continuing	TBD
5029	Space Sensor & CM Tech	0	0	7,038	8,737	5,650	1,687	1,186	Continuing	TBD
5030	Applied Space Access Vehicle Tech	0	0	1,302	1,740	2,818	2,020	3,401	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: This is 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.

Page 1 of 21 Pages

Exhibit R-2 (PE 0602500F)

	RDT&E BUDGET ITEM JUS	TIFICATION SHEET (R-2 Exhib	oit)	DATE Februa	ary 2002					
BUDO 02 -	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602500F MULTI-D	ISCIPLINARY S	PACE TECH						
In FY Fund	FY 2003, this program anticipates receiving \$43.0 million from the Cost of War Transfer Account. These funds are not included in the FY 2003 Air Force baseline. anding will be used to advance technologies in support of space-based radar efforts.									
(U)	A. Mission Description This program advances the technology base in multiple di Laser and imaging space technologies develop concepts f energy laser weapon systems. 2) Human centered applied and on-demand space missions. 3) Space materials conce maintainability, and performance. 4) Rocket propulsion of application of advanced materials for rockets and ballistic develop advanced and combined cycle engine technologies develop technologies to generate, control, process, receive technologies focus on generation, control, reception and p reconnaissance, warning, electronic combat, and counterr access to space.	isciplines for future space applications in eight pro- for advanced, very long-range optical systems and d space technologies focus on the human interface entrate on the materials technology base for space component technologies advance technology in li- c missiles to achieve revolutionary launch capabilities for revolutionary low-cost access to space. 6) e, and transmit opto-electronic signals for space sporocessing of electronic and electromagnetic sign measures. 8) Applied space access vehicle technology	rojects, each focusing d assess the vulnerabil e concepts that impro- ecraft and launch syste iquid propulsion rocke lities. 5) High-speed Space sensors, photor sensor applications. 7) als for space sensor ap blogies develop advan	on a separate technolo lity of satellites to the ve satellite operations ems to improve afford et engines, solid rocke airbreathing propulsio nics, and radio frequer) Space sensors and c pplications in intellige aced concepts for affor	ogy area. 1) effects of high during routine ability, et motors, and on technologies ncy processes, ountermeasures ence, surveillance, rdable on-demand					
(U)	<u>B. Budget Activity Justification</u> This program in Budget Activity 2, Applied Research, sin technologies.	nce it develops and determines the technical feasi	bility and military util	lity of evolutionary an	nd revolutionary					
(U)	C. Program Change Summary (\$ in Thousands)									
(U) (U) (U)	Previous President's Budget Appropriated Value Adjustments to Appropriated Value a. Congressional/General Reductions b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram e. Rescissions Adjustments to Budget Years Since FY 2002 PBR	<u>FY 2001</u> 0 0	<u>FY 2002</u> 0 0	<u>FY 2003</u> 0 53,592	<u>Total Cos</u> t					
		Page 2 of 21 Pages		Exhibit R-2	(PE 0602500F)					

	RDT&E BUDGET ITEM JUSTIFICATION	DATE Fe	DATE February 2002			
budg 02 -	Applied Research	PE NUMBER AN 0602500F	ND TITLE MULTI-D		SPACE TECH	4
(U)	C. Program Change Summary (\$ in Thousands) Continued		FY 2001	FY 2002	FY 2003	Total Cost
(U)	Current Budget Submit/FY 2003 PBR		0	0	53,592	TBD
(U)	Significant Program Changes: This is a new PE, but not a New Start, resulting from the Space Commission	recommendation	n to consolida	ate all space unique a	ctivities.	
	Ρаσе	3 of 21 Pages			Exhibit	R-2 (PE 0602500F)

	RDT&E	BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		[DATE Febru	ary 2002
budo 02 -	GET ACTIVITY • Applied Resear	ch			PE NUMBE 060250	R AND TITLE	FI-DISCIP	LINARY	SPA	CE TECH	PROJECT 5023
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 20 Estim	007 Cost to ate Complete	Total Cost
5023	Laser & Imaging Sp	ace Tech	0	0	1,273	1,083	1,012	420		398 Continuin	g TBD
Note cons	: In FY 2003, space un olidate all space unique	ique efforts transferred from P activities.	E 0602605F	, Project 480	56, into this p	project in co	njunction wi	th the Space	e Comm	nission recomm	endation to
(U)	J) <u>A. Mission Description</u> This project examines the technical feasibility of laser and imaging technologies that are uniquely space-oriented technology including advanced, very long-range optical system concepts for both imaging and beam projection applications. It also supports the modeling and analysis of satellite objects to assess vulnerability to laser radiation and to support the space situational awareness mission. Near-term focus is on the continued assessment of satellite vulnerabilities and their investigation of optical approaches to meet optical quality requirements for ultra-light, large aperture, space-based optical systems.										
(U) (U) (U)	<u>FY 2001 (\$ in Thousa</u> \$0 \$0	unds) No Activity Total									
(U) (U) (U)	<u>FY 2002 (\$ in Thousa</u> \$0 \$0	unds) No Activity Total									
(U) (U)	 FY 2003 (\$ in Thousands) \$636 Develop and field test advanced optics technologies to support beam projection and imaging applications associated with large aperture lightweight optics. Investigate, test, and characterize larger size advanced optics/liquid crystal optical devices scalable to high power beam projection applications. By decreasing the number of system components and extending the wavelength coverage, this technology has the 										
(U)	\$637	potential to enable the use of ultra-light, large aperture mirrors in space-based optical systems. Assess the vulnerability of five new United States, North Atlantic Treaty Organization, or foreign satellites to the effects of high-energy laser weapons. Update previously completed assessments on catalogued satellites. Incorporate improved algorithms and hardware for rapidly characterizing new launches into current data fusion workstations for the space situational awareness mission.									
(U)	\$1,273	Total									
P	roject 5023			Page	4 of 21 Page	es				Exhibit R-2/	(PE 0602500F)
					160						

	RDT&E BUDGET ITEM JUSTIFICATION S	SHEET (R-2A Exhibit)	DATE February 2002
BUD(02 ·	GET ACTIVITY - Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPA	PROJECT ACE TECH 5023
(U)	B. Project Change Summary Not Applicable.		
(U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602605F, Directed Energy Technology. PE 0603444F, Maui Space Surveillance Systems. PE 0603500F, Multi-Disciplinary Adv Dev Space Technology. PE 0603605F, Advanced Weapons Technology. This project has been coordinated through the Reliance process to harmonize	efforts and eliminate duplication.	
(U)	D. Acquisition Strategy Not Applicable.		
(U) (U)	E. Schedule Profile Not Applicable.		
F	Project 5023 Page	5 of 21 Pages	Exhibit R-2A (PE 0602500F)

	RDT&E	BUDGET ITEM JU	STIFIC	ATION	SHEET	(R-2A E	xhibit)		D	Februa	ary 2002
виро 02 -	BET ACTIVITY Applied Resear	ch			PE NUMBE 060250	R AND TITLE	FI-DISCIP	LINARY	SPAC	E TECH	PROJECT 5024
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 200 Estima	07 Cost to te Complete	Total Cost
5024	Human Centered A	pplied Space Tech	0	0	496	693	869	0		0 Continuing	TBD
Note conso (U)	 Note: In FY 2003, space unique efforts transferred from PE 0602202F, Project 7184, into this project in conjunction with the Space Commission recommendation to consolidate all space unique activities. Outyear funding profiles will be addressed in future budget activities. U) <u>A. Mission Description</u> This project identifies and develops human and crew interface concepts and technologies that improve satellite operations, satellite attack reporting, and crew situational awareness during routine and on-demand space missions. Payoffs include faster satellite reconfiguration for time-critical targeting, improved situational 										
(U) (U) (U)	awareness of the spac <u>FY 2001 (\$ in Thousa</u> \$0 \$0	e battlespace, and lower cost fo unds) No Activity Total	or operations	s, training, ar	nd moderniz	ation due to	reduced mar	nning and co	ntrol sta	tion standardiza	tion.
(U) (U) (U)	<u>FY 2002 (\$ in Thouse</u> \$0 \$0	unds) No Activity Total									
(U) (U)	 J) <u>FY 2003 (\$ in Thousands</u>) J) \$496 Develop and evaluate new crew interface concepts for satellite attack reporting, having the optimal mix of human interface technologies that maximize crew situational awareness. Identify new human roles for on-orbit servicing, prepare a satellite control station simulator as an evaluation testbed, and begin to develop a multi-sensory control station interface usable across systems. 										
(U)	\$496	Total									
(U)	B. Project Change S Not Applicable.	<u>ummary</u>									
Р	roject 5024			Page	6 of 21 Pag	es				Exhibit R-2A	(PE 0602500F)
					162						

RDT&	E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE Februar	y 2002
BUDGET ACTIVITY 02 - Applied Resea	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SP	ACE TECH	PROJECT 5024
 (U) <u>C. Other Program H</u> (U) Related Activities: (U) PE 0602202F, Huma (U) This project has been 	'unding Summary (\$ in Thousands) In Effectiveness Applied Research. coordinated through the Reliance process to harmonize efforts and eliminate duplication.		
(U) D. Acquisition Strat Not Applicable.	2gy		
(U) <u>E. Schedule Profile</u>(U) Not Applicable.			
Project 5024	Page 7 of 21 Pages	Exhibit R-2A (P	E 0602500F)
	163		

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)										nry 2002
BUDO 02 -	BET ACTIVITY				PE NUMBE	R AND TITLE	FI-DISCIP	PLINARY	SPACE	TECH	PROJECT 5025
	COST (\$ in Thousands)		FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5025	Space Materials Development		0	0	18,608	20,449	23,888	24,144	24,676	Continuing	TBD
Note Com (U)	 Note: In FY 2003, space unique efforts were transferred from PE 0602102F, Projects 4347, 4348, 4349, and 5015, into this project in conjunction with the Space Commission recommendation to consolidate all space unique activities. U) <u>A. Mission Description</u> This project develops the materials and processing technology base for spacecraft and launch systems to improve affordability, maintainability, and performance of current and future Air Force space systems. Families of affordable lightweight materials are being developed, including metals, polymers, ceramics, metallic composites, and nonmetallic composites, to provide new capabilities for spacecraft, ballistic missile, and propulsion systems to meet the future space requirements. Advanced thermal protection materials are being developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet space and ballistic missile requirements. Develops materials technologies for surveillance and terrestrial situational awareness systems and subsystems for space and ballistic missile applications. 										
(U) (U) (U)	FY 2001 (\$ in Thousands)\$0No Activity\$0Total										
(U) (U) (U)	FY 2002 (\$ in Thousands)\$0No Activity\$0Total										
(U) (U)	 J) <u>FY 2003 (\$ in Thousands</u>) J) \$11,484 Develop materials and processes to dramatically improve performance, durability, and cost of rocket propulsion systems. Evaluate new candidate materials for rocket engines such as metal matrix composites, ceramics, and advanced organic composites for use in liquid oxygen, liquid hydrogen, high-temperature, and high-pressure environments. Identify and evaluate the applications of these materials to turbopump housings, ducts, valves, solid rocket casings, insulation, nozzle throats, and spacecraft propulsion. Develop material property databases and initiate demonstration of suitability for application using representative geometry and processing conditions for the intended rocket engine components. 										
(С) Р	roject 5025	organic, auvaliced	i su ucturar a	Page	8 of 21 Page			An Porce sp	E	xhibit R-2A	(PE 0602500F)

BUDGET ACTIVITY PE NUMBER AND TITLE PRC 02 - Applied Research 0602500F MULTI-DISCIPLINARY SPACE TECH 50 (U) A. Mission Description Continued 1 1 (U) FY 2003 (\$ in Thousands) Continued 1 1 1 (U) FY 2003 (\$ in Thousands) Continued 1 1 1 (U) FY 2003 (\$ in Thousands) Continued 1 1 1 1 (U) FY 2003 (\$ in Thousands) Continued 1 <th>02</th>	02
 (U) A. Mission Description Continued (U) FY 2003 (\$ in Thousands) Continued tailorable thermal control coatings with controlled heat dissipation for spacecraft thermal control. Establish baseline effects of the space environment on polymer and thermal control coatings. Optimize processing methods for the metallic materials which are expected to be for lightweight, high-strength components in future space vehicles. Test non-autoclave materials and processes for composite cryogenic to structures for future Air Force space platforms. (U) \$1,439 Develop and demonstrate materials and materials processing technologies to enable improved performance, affordability, and performance surveillance, tracking, targeting, and situational awareness systems. Refine improved thin film processing techniques to optimize efficier solar cells. Validate and transition materials processing techniques and materials for space applications capable of detect very long wavelengths. (U) \$18,608 Total (U) B. Project Change Summary Not Applicable. (U) C. Other Program Funding Summary (\$ in Thousands) (U) Related Activities: 	[•] ROJECT 5025
 (U) <u>FY 2003 (\$ in Thousands) Continued</u> tailorable thermal control coatings with controlled heat dissipation for spacecraft thermal control. Establish baseline effects of the space environment on polymer and thermal control coatings. Optimize processing methods for the metallic materials which are expected to be for lightweight, high-strength components in future space vehicles. Test non-autoclave materials and processes for composite cryogenic to structures for future Air Force space platforms. (U) \$1,439 Develop and demonstrate materials and materials processing technologies to enable improved performance, affordability, and performance surveillance, tracking, targeting, and situational awareness systems. Refine improved thin film processing techniques to optimize efficient solar cells. Validate and transition materials processing techniques and materials that will enable high performance optical control of pha array radar and satellite-to-satellite data links. Demonstrate alternative infrared detector materials for space applications capable of detectivery long wavelengths. (U) \$18,608 Total (U) B.Project Change Summary Not Applicable. (U) C. Other Program Funding Summary (\$ in Thousands) (U) Related Activities: 	
 (U) \$1,439 Develop and demonstrate materials and materials processing technologies to enable improved performance, affordability, and performance surveillance, tracking, targeting, and situational awareness systems. Refine improved thin film processing techniques to optimize efficient solar cells. Validate and transition materials processing techniques and materials that will enable high performance optical control of pha array radar and satellite-to-satellite data links. Demonstrate alternative infrared detector materials for space applications capable of detector very long wavelengths. (U) \$18,608 Total (U) B. Project Change Summary Not Applicable. (U) C. Other Program Funding Summary (\$ in Thousands) (U) Related Activities: 	ce be used iic tank
 (U) \$18,608 Total (U) B. Project Change Summary Not Applicable. (U) C. Other Program Funding Summary (\$ in Thousands) (U) Related Activities: 	ance of viency in phased tecting
 (U) <u>B. Project Change Summary</u> Not Applicable. (U) <u>C. Other Program Funding Summary (\$ in Thousands)</u> (U) Related Activities: 	
 (U) <u>C. Other Program Funding Summary (\$ in Thousands)</u> (U) Related Activities: 	
 (U) PE 0602102F, Materials. (U) PE 0603112F, Advanced Materials for Weapon Systems. (U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology. (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. 	
(U) <u>D. Acquisition Strategy</u> Not Applicable.	
 (U) <u>E. Schedule Profile</u> (U) Not Applicable. 	
Project 5025Page 9 of 21 PagesExhibit R-2A (PE 0602)	02500F)

	RDT&E BUDGET ITEM JU	JSTIFIC		SHEET	(R-2A E	xhibit)			DATE Februa	ary 2002
BUDO 02 -	GET ACTIVITY - Applied Research			PE NUMBE 060250	R AND TITLE	FI-DISCIP	LINARY	SPA	CE TECH	PROJECT 5026
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 20 Estim	007 Cost to nate Complete	Total Cost
5026	Rocket Propulsion Component Tech	0	0	19,612	31,048	32,543	33,206	33	3,708 Continuing	TBD
Note cons	: In FY 2003, space unique efforts transferred from I olidate all space unique activities.	PE 0602203F	, Project 484	47, into this	project in co	njunction wi	th the Space	Comn	nission recommer	dation to
(U)	U) <u>A. Mission Description</u> This project develops advances in rocket technologies for space access, maneuver, and ballistic missiles. Analytical and experimental areas of emphasis are propellants, combustion, rocket materials, sustainment of strategic systems, and novel space propulsion concepts. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of future space and missile launch subsystems. Technologies are developed to reduce the weight and cost of components using new materials and improved designs and manufacturing techniques. All efforts in this project are part of the Integrated High Payoff Rocket Propulsion Technology program, a joint Department of Defense, National Aeronautics and Space Administration, and industry effort to focus rocket propulsion technology on national needs.									
(U) (U) (U)	FY 2001 (\$ in Thousands)\$0No Activity\$0Total									
(U) (U) (U)	FY 2002 (\$ in Thousands)\$0No Activity\$0Total									
(U) (U)	 J) <u>FY 2003 (\$ in Thousands</u>) J) \$2,082 Develop, characterize, and test advanced hydrocarbons and energetic, reduced-toxicity monopropellants to increase space launch payload capability. Refine synthesis methods of new propellants to facilitate the transition from producing lab-scale quantities to producing sufficient material to meet operational requirements. Continue scale-up of selected propellants for laboratory and demonstrator engine evaluations. Develop high-energy-density oxidizers and polymeric binders and optimize paths for incorporating these materials into propellants with significantly enhanced performance. Continue evaluating the potential of monopropellants comprised of reduced-toxicity ionic salts to reduce the cost of space access and space operations. The goal is monopropellants with performance equivalent to bipropellants. Continue to evaluate selected propellants in advanced combustion devices to determine materials compatibility and performance. Continue to model and analyze 									
Р	Project 5026		Page	10 of 21 Pag	ges				Exhibit R-2A	(PE 0602500F)
			UNC	166 LASSIFI	ED					

	RDT&E	BUDGET ITEM JUSTIFICATION S	HEET (R-2A Exhibit)	DATE February	y 2002
виро 02 -	GET ACTIVITY • Applied Resear	ch	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPA	CE TECH	PROJECT 5026
(U)	A. Mission Descripti	on Continued			
(U)	FY 2003 (\$ in Thousa	nds) Continued			
(U)	\$1,017	advanced propulsion concepts with enhanced performa Develop advanced liquid engine combustion technolog engine uses in heavy lift space vehicles. Continue to c compatibility and prevent damage to test and operation	nce and reliability such as laser-propelled lightcraft. by for improved performance while preserving chambe haracterize, study, and evaluate injector performance to al combustion devices. Continue to develop, analyze.	r lifetime and reliabil o ensure chamber/inj and model advanced	lity needs for jector d combustion
(U)	\$2,797	devices and injectors compatible with new energetic pr performance and reliability such as rocket-based comb Continue to develop advanced material applications fo space systems. Develop advanced ablative component characterize and develop new high temperature polyme and propulsion systems to meet lower weight, increase	ropellants. Continue to model and analyze advanced p ined cycle engines and pulsed detonation engines. r lightweight components and material property enhan s using hybrid polymers for use in current and future l er components and carbon-carbon components for use d strength, and lower cost requirements. Continue to	ropulsion concepts w cements for use in lav aunch systems. Cont in advanced combust develop advanced mo	vith enhanced unch and tinue to tion devices otor casings
(U)	\$5,250	and propellant system components for high-energy pro Continue to develop propulsion component technology single stage hydrogen turbopump for advanced cryoge for space boosters and air-launched missiles. Initiate to	pellants. for reliable, safe, and low-cost boost systems. Comp nic engines. Continue development of components for esting of injector for hydrocarbon or cryogenic fuel an	lete development and hybrid propulsion te	l begin testing echnologies
(U)	\$3,208	Continue development of lightweight combustion char engine nozzle for upper stage and space booster applic stage engines.	nber and nozzle technology. Continue development of ations. Initiate design study for high pressure turbopu	f advanced lightweight mps for use in advance	ht rocket ced upper
(U)	\$2,586	Continue demonstration of missile propulsion technolo test database for aging and surveillance technology for of an advanced lightweight solid rocket motor. Contin strategic systems and other solid rocket motors. Contin	by and Post Boost Control Systems (PBCS) and integ sustainment of current Intercontinental Ballistic Miss ue demonstration of tools to increase the capability to nue demonstration of advanced full-scale, flight-like P	rate results of aging r ile fleet. Continue de determine the service BCS.	models and emonstration e life of
(U) (U)	\$2,672 \$19.612	Develop solar electric and solar thermal propulsion tec satellites and satellite constellations. Complete Hall th Continue development of microsatellites (<25 kg) prop developing solar thrusters and concentrators for future Continue development of high power solar thermal con Total	hnologies for stationkeeping, repositioning, and orbit ruster development efforts to achieve Air Force orbit to oulsion systems (e.g., plasma thrusters) for advanced in orbital transfer vehicles. Continue testing of an electr nponents.	transfer for large com ransfers using electri naging missions. Co ically controlled solid	umunication c propulsion. ontinue d propellant.
P	roject 5026	Page 1	1 of 21 Pages	Exhibit R-2A (PI	E 0602500F)

	RDT&E BUDGET ITEM JUSTIFICATION S	SHEET (R-2A Exhibit)	DATE February 2002		
BUDO 02 -	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPA	CE TECH 50	ROJECT 026	
(U)	B. Project Change Summary Not Applicable.				
(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	 C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0601102F, Defense Research Sciences. PE 0602114N, Power Projection Applied Research. PE 0602203F, Aerospace Propulsion. PE 0602303A, Missile Technology. PE 0602805F, Dual Use Science and Technology. PE 0603216F, Aerospace Propulsion and Power Technology. PE 0603500F, Multi-Disciplinary Adv Dev Space Technology. This project has been coordinated through the Reliance process to harmonize 	efforts and eliminate duplication.			
(U)	D. Acquisition Strategy Not Applicable.				
(U) (U)	E. Schedule Profile Not Applicable.				
Р	Project 5026 Page	12 of 21 Pages	Exhibit R-2A (PE 060	2500F)	
	UNC	168 LASSIFIED			

	RDT&E	DATE	DATE February 2002								
вирс 02 -	BET ACTIVITY Applied Resear	ch			PE NUMBE	R AND TITLE	FI-DISCIF	LINARY	SPACE	ТЕСН	PROJECT 5027
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5027	High Speed Airbrea	thing Prop Tech	0	0	4,238	4,668	4,904	5,094	5,210	Continuing	TBD
Note conse	: In FY 2003, space un plidate all space unique	nique efforts transferred from P e activities.	E 0602203F	, Project 301	12, into this p	project in co	njunction wi	ith the Space	e Commissio	on recommer	dation to
(U)	U) <u>A. Mission Description</u> This project develops hypersonic propulsion technologies to enable revolutionary propulsion options providing lower cost access to space for the Air Force. These new engine technologies will enable future space launch concepts. The short-term focus is on hydrocarbon fueled engines capable of operating over a broad range of flight Mach numbers and longer term focus will be on hydrogen fueled scramjet powered engines that can enable the higher Mach numbers of achieving access to space. Technologies developed under this program enable capabilities of interest to both Department of Defense and National Aeronautical and Space Administration. Efforts include modeling and simulation, proof of concept demonstrations of critical components, advanced component development, and ground-based demonstrations.										
(U) (U) (U)	<u>FY 2001 (\$ in Thousa</u> \$0 \$0	<u>ands)</u> No Activity Total									
(U) (U) (U)	<u>FY 2002 (\$ in Thousa</u> \$0 \$0	ands) No Activity Total									
(U) (U)	FY 2003 (\$ in Thouse \$233	nds) Initiate development of flight engine.	demonstrate	or vehicle co	ncepts. Con	duct vehicle	e design trad	es for integr	ation of hyd	rocarbon fue	led scramjet
(U) (U)	\$987 \$301	Increase scramjet operating range (Mach 3 to >Mach 8) to provide robust options for combined cycle engines. Conduct initial feasibility assessment of variable geometry devices. Investigate variable geometry through collaborative effort with France and Russia. Conduct assessment of advanced airbreathing engines/Combined Cycle Engines (CCEs) to establish and extend operability limits. Enables development of low internal drag scramjet flowpath for reusable applications. This supports the development of affordable, on-demand access to space vehicles.									
Р	roject 5027			Page	13 of 21 Pag	ges			E	hibit R-2A	(PE 0602500F)

	RDT&E BUDGET ITEM JUSTIFICATION	SHEET (R-2A Exhibit)	DATE February 2002
виро 02 -	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPA	PROJECT
(U)	<u>A. Mission Description Continued</u>		
(U) (U)	\$2,717 Initiate development of critical components for advan Initiate development of high performance/low interna on-demand access to space vehicles.	ced airbreathing engines and CCEs for robust performa l drag devices. This provides robust scramjet compone	ance over extended Mach range. ents applicable to affordable,
(U)	\$4,238 Total		
(U)	B. Project Change Summary Not Applicable.		
(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0601102F, Defense Research Sciences. PE 0602201F, Aerospace Flight Dynamics. PE 0602203F, Aerospace Propulsion. PE 0602602F, Conventional Munitions. PE 0602702E, Tactical Technology. PE 0603111F, Aerospace Structures. PE 0603216F, Aerospace Propulsion and Power Technology. PE 0603601F, Conventional Weapons Technology. PE 0603601F, Conventional Weapons Technology. Program is reported to/coordinated by the Joint Army/Navy/NASA/Air Force This project has been coordinated through the Reliance process to harmonize	e (JANNAF) Executive Committee. efforts and eliminate duplication.	
(U)	D. Acquisition Strategy Not Applicable.		
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.		
Р	roject 5027 Page	14 of 21 Pages	Exhibit R-2A (PE 0602500F)
		170	

	RDT&E BUDGET ITEM JU	C	DATE February 2002							
BUDGET ACTIVITY 02 - Applied	Research			PE NUMBE	R AND TITLE	I-DISCIP	LINARY	SPAC	CE TECH	PROJECT 5028
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 200 Estima	07 Cost to ate Complete	Total Cost
5028 Space S	Sensors, Photonics & RF Proc	0	0	1,025	1,602	2,064	1,871	4,	491 Continuing	TBD
Note: In FY 2002 consolidate all sp	3, space unique efforts transferred from P ace unique activities.	E 0602204F	, Project 20	02, into this	project in co	onjunction w	ith the Spac	e Comn	nission recomme	ndation to
(U) <u>A. Mission</u> This projec for radio fr precision er lower powe radar techn	A. Mission Description This project focuses on developing methods of generating, controlling, receiving, transmitting, and processing photonic, optical, and opto-electronic (mixed) signals for radio frequency (RF) space sensor applications. The enabling technologies will be used for intelligence, surveillance, reconnaissance, electronic warfare, and precision engagement sensors based in space. The project aims to demonstrate significantly improved military space sensors of smaller size, lower weight, lower cost, lower power dissipation, higher reliability, and improved performance. This project also develops and assesses multi-dimensional adaptive processing techniques in radar technology for affordable and reliable space surveillance and reconnaissance systems.									
(U) <u>FY 2001 (\$</u> (U) \$0 (U) \$0	<u>in Thousands)</u> No Activity Total									
(U) <u>FY 2002 (\$</u> (U) \$0 (U) \$0	<u>s in Thousands)</u> No Activity Total									
 (U) <u>FY 2003 (\$</u> (U) \$368 (U) \$191 (U) \$370 (U) \$96 (U) \$1,025 	 FY 2003 (\$ in Thousands) \$368 Develop high performance integrated photonic technology link, interconnect, and switching components and subsystems for wideband RF phased array antenna beamforming, and for high data rate space sensors and communications systems. \$191 Develop efficient, high coefficient chip-scale optical waveguide technology for mixed signal component subsystems. \$370 Perform independent modeling, test, and evaluation for space-qualified photonic components and integrated devices. \$96 Initiate the study of adaptive processing techniques for multi-mission conformal arrays for space sensor data. \$1,025 Total 									
(U) <u>B. Project</u> Not Applic	Change Summary able.									
Project 5028			Page	15 of 21 Pag	jes				Exhibit R-2A	(PE 0602500F)

RDT&E BUDGET ITEM JUSTIFIC	ATION SHEET (R-2A Exhibit)	DATE February 2002		
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SP	ACE TECH 5028	т	
 (U) <u>C. Other Program Funding Summary (\$ in Thousands)</u> (U) Related Funding: (U) PE 0602204F, Aerospace Sensors. (U) PE 0603203F, Advanced Aerospace Sensors. (U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology. (U) This project has been coordinated through the Reliance process to the sensor of the sens	o harmonize efforts and eliminate duplication.			
(U) <u>D. Acquisition Strategy</u> Not Applicable.				
 (U) E. Schedule Profile (U) Not Applicable. 				
Project 5028	Page 16 of 21 Pages	Exhibit R-2A (PE 0602500	F)	

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)									DATE February 2002	
BUD0 02 -	BET ACTIVITY Applied Resear	ch			PE NUMBE	R AND TITLE	FI-DISCIP	LINARY	SPACE	ТЕСН	PROJECT 5029
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5029	Space Sensor & CM	M Tech	0	0	7,038	8,737	5,650	1,687	1,186	Continuing	TBD
Note recor	: In FY 2003, space ur nmendation to consolid	nique efforts transferred from P date all space unique activities.	E 0602204F	, Projects 20	02, 6095, an	nd 7622, into	this project	in conjuncti	ion with the	Space Comr	nission
(U)	J) <u>A. Mission Description</u> This project focuses on developing processes and techniques for electronic and electromagnetic signal processing for intelligence, surveillance, and reconnaissance (ISR) space sensor applications. This project develops the baseline technologies required to manage and perform on-board space sensor information fusion for timely and comprehensive communications and situational awareness. Through modeling and simulation, this project develops and evaluates innovative electromagnetic and electronic sensing concepts for space applications.										
(U) (U) (U)	<u>FY 2001 (\$ in Thousa</u> \$0 \$0	<u>ands)</u> No Activity Total									
(U) (U) (U)	<u>FY 2002 (\$ in Thousa</u> \$0 \$0	ands) No Activity Total									
(U) (U)	 U) FY 2003 (\$ in Thousands) U) \$1,663 Develop compact, affordable, multi-function receiver/exciter and phased array components for communications, Global Positioning System, radar, electronic warfare, and other ISR space sensors. Fabricate critical components consisting of gallium arsenide, indium phosphide, silicon, and/or wide bandgap devices for use in multi-mode/multi-function digital receiver prototype modules, and demonstrate a feasible architecture for performing midels and direct digital complexity formula. 										
(U)	\$87	Develop microwave technologies for advanced radio frequency apertures and phased array antennas used in military ISR space sensors. Develop and demonstrate robust components for L-band and X-band transmitter and receiver (T/R) channels that operate with limited environmental controls and under severe electromagnetic stress									
(U)	\$514	Demonstrate X-band sub-assemblies based on flexible RF membranes that enable low-cost and low-mass T/R channels integrated at the subarray level for space applications.									
Р	roject 5029			Page	17 of 21 Pag	ges			Ex	hibit R-2A	(PE 0602500F)

	RDT&E	A Exhibit)	DATE February 2002							
BUDO 02 -	GET ACTIVITY Applied Resear	PE NUMBER AND Ch 0602500F	TITLE AULTI-DISCIPLINARY SPA	CE TECH	PROJECT 5029					
(U)	A. Mission Description	on Continued								
(U) (U)	FY 2003 (\$ in Thousa \$101	nds) Continued Characterize and mature space-qualified micro-electro-mechanical syste a ten-to-one bandwidth.	ms phase shifters for extended switc	h lifetimes and able	to operate over					
(U) (U)	 \$514 Refine materials and processes for two-dimensional and three-dimensional interconnects for space applications. \$639 Continue to refine the accuracy of predictions of the scattering phenomenology associated with electromagnetic radiation returned from objects or backgrounds when viewed from space. 									
(U)	\$1,730 Develop space-qualified precision time, position, and velocity sensors capable of operating in jamming environments enabling multiple platform sensor-to-shooter operations. Continue development of Global Positioning System specific jamming mitigation techniques for operation in hostile radio frequency environments with emphasis on synergistic integration of anti-jam technologies. Develop virtual flight test technology for improved assessment of reference sensors for space applications.									
(U)	\$1,790 Develop technology to enable affordable upgrades to space-qualified radio frequency signal receivers. Model threat identification algorithms for next generation threat warning receivers. Evaluate state-of-the-art radar and electronic warfare digital receiver subsystems with Gallium Arsenide and Indium Phosphide radio frequency components (Analog-to-Digital Convertors, filters, mixers, etc.) for laboratory environment scenario testing.									
(U)	\$7,038	Total								
(U)	<u>B. Project Change Se</u> Not Applicable.	<u>immary</u>								
(U) (U) (U) (U) (U) (U)	 J. C. Other Program Funding Summary (\$ in Thousands) J. Related Activities: J. PE 0602204F, Aerospace Sensors. J. PE 0603203F, Advanced Aerospace Sensors. J. PE 0603500F, Multi-Disciplinary Adv Dev Space Technology. J. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. 									
(U)	D. Acquisition Strategy Not Applicable.									
(U)	E. Schedule Profile									
Р	roject 5029	Page 18 of 21 Pages		Exhibit R-2A (F	PE 0602500F)					

	RDT&E BUDGET ITEM JUSTIFICATI	DATE February 2002		
BUDO 02 -	BET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPA	PROJECT	
(U) (U)	E. Schedule Profile Continued			
(0)				
Р	roject 5029	Page 19 of 21 Pages	Exhibit R-2A (PE 0602500F)	
		175 UNCLASSIFIED		

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)										DATE February 2002	
BUDO 02 -	BET ACTIVITY Applied Resear	ch			PE NUMBE	R AND TITLE	FI-DISCIF	LINARY	SPAC	E TECH	PROJECT 5030	
	COST (\$ in	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 200 Estima	07 Cost to te Complete	Total Cost	
5030	Applied Space Acce	ess Vehicle Tech	0	0	1,302	1,740	2,818	2,020	3,	401 Continuing	TBD	
Note conse	In FY 2003, space un blidate all space unique	ique efforts transferred from P activities.	E 0602201F	F, Project 240)3, into this p	project in co	njunction wi	th the Space	e Commi	ission recommer	idation to	
(U)	U) <u>A. Mission Description</u> This project develops technologies in areas of advanced structures, flight controls, and aerodynamics to enable affordable on-demand military access to space. Resulting technologies contribute significantly towards the development of reliable, responsive space access systems with aircraft-like operations. Payoffs to the warfighter include enhanced mission effectiveness, improved flight safety, improved maintenance, and decreased size, weight, and cost. Leverages a network of virtual environments for evaluation of advanced concepts.											
(U) (U) (U)	<u>FY 2001 (\$ in Thousa</u> \$0 \$0	nnds) No Activity Total										
(U) (U) (U)	<u>FY 2002 (\$ in Thousa</u> \$0 \$0	nnds) No Activity Total										
(U) (U)	 <u>FY 2003 (\$ in Thousands</u>) U) \$1,302 Develop advanced structure, flight control, and aerodynamic technologies to enable aircraft-like operations for affordable on-demand military access to space. Define and develop integrated guidance and control laws to expand launch vehicle performance envelope. Develop capability to simulate space access operability in a virtual environment. 											
(U)	\$1,302	Total										
(U)	B. Project Change S Not Applicable.	<u>ummary</u>										
Р	roject 5030			Page	20 of 21 Pag	es				Exhibit R-2A	(PE 0602500F)	
	176											

	RDT&E BUDGET ITEM JUSTIFICATION S	SHEET (R-2A Exhibit)	DATE February 2002
budg 02 -	ET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPA	PROJECT
(U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Funding: PE 0602201F, Aerospace Flight Dynamics. PE 0602202F, Human Effectiveness Applied Research. PE 0602204F, Aerospace Sensors. PE 0603211F, Aerospace Technology Dev/Demo. This project has been coordinated through the Reliance process to harmonize	efforts and eliminate duplication.	
(U)	D. Acquisition Strategy Not Applicable.		
(U) (U)	E. Schedule Profile Not Applicable.		
Pr	roject 5030 Page	21 of 21 Pages	Exhibit R-2A (PE 0602500F)
		177	

THIS PAGE INTENTIONALLY LEFT BLANK

PE TITLE: Space Technology

	RDT&E BUDGET ITEM J	DATE	DATE February 2002							
BUDGET 02 - A	r activity Applied Research		PE NUMBER AND TITLE 0602601F Space Technology							
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	67,139	81,344	58,582	68,437	75,056	76,799	78,665	Continuing	TBD
1010	Space Survivability & Surveillance	27,164	31,063	11,938	19,396	20,912	21,309	21,943	Continuing	TBD
4846	Spacecraft Payload Technologies	8,057	14,777	10,631	9,900	13,973	14,321	14,709	Continuing	TBD
5018	Spacecraft Protection Technology	0	0	4,620	3,948	2,552	2,351	2,157	Continuing	TBD
8809	Spacecraft Vehicle Technologies	31,918	35,504	31,393	35,193	37,619	38,818	39,856	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	Continuing	TBD

Note: In FY 2003, Project 1010 is split, with efforts focused on protecting spacecraft from manmade threats being transferred into Project 5018.

(U) <u>A. Mission Description</u>

This PE focuses on four major areas. First, space systems protection develops technologies to understand, mitigate, and exploit effects of weather and geophysics environments on the design and operation of Air Force systems. Second, spacecraft payload technologies improve satellite payload operations by investigating advanced component and subsystem capabilities. Third, spacecraft vehicles, focuses on spacecraft platform, payload, and control technologies, and their interactions. The last major area, spacecraft protection, develops technologies for protecting U.S. space assets in potential hostile environments. Note: In FY 2002, Congress added \$20.6 million (\$1.3 million for Mixed Signal Very Large Scale Integrated (Circuits) for Space Vehicle Communication Subsystems, \$8.5 million for the High-frequency Active Auroral Research Program (HAARP) Space Technology, \$1.7 million for HAARP Electromagnetic Wave Gradiometer, \$2.6 million for HAARP Incoherent Radar, \$1.8 million for Satellite Simulation Took Kit, \$3.0 million for Composite Cryogenic Fuel Tanks, and \$1.7 million for Terabit).

(U) <u>B. Budget Activity Justification</u>

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

 Page 1 of 18 Pages
 Exhibit R-2 (PE 0602601F)

 179
 179

	RDT&E BUDGET ITEM JUSTIFIC	DATE Febru	DATE February 2002		
BUD	GET ACTIVITY	PE NUMBER AND TITLE			
02 ·	· Applied Research	0602601F Space Te			
(U)	C. Program Change Summary (\$ in Thousands)				
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	Total Cos
(U)	Previous President's Budget	68,850	61,086	56,479	
(U)	Appropriated Value	69,487	81,686		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions		-342		
	b. Small Business Innovative Research	-1,650			
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram	-61			
	e. Rescissions	-637			
(U)	Adjustments to Budget Years Since FY 2002 PBR			2,103	
(U)	Current Budget Submit/FY 2003 PBR	67,139	81,344	58,582	TBD
(U)	Significant Program Changes:				
	Not Applicable.				

Page 2 of 18 Pages

	RDT&	E BUDGET ITEM JU	STIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ary 2002
виро 02 -	ET ACTIVITY Applied Resea	rch			PE NUMBER AND TITLE 0602601F Space Technology						PROJECT 1010
	COST (\$ in Thousands) FY 2001 FY 2002 Actual Estimate					FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
1010	Space Survivability	y & Surveillance	27,164	31,063	11,938	19,396	20,912	21,309	21,943	Continuing	TBD
Note: (U)	 Dete: In FY 2003, Project 1010 is split, with efforts focused on protecting spacecraft from manmade threats being transferred into Project 5018. <u>A. Mission Description</u> This project develops the technologies to exploit the aerospace environment to the warfighter's benefit. The project focuses on characterizing the battlespace environment for realistic space system design, modeling, and simulation. It includes technologies to specify and forecast the environment from 'mud to sun' for planning operations and ensuring uninterrupted system performance and technologies to optimize space-based surveillance operations. Finally, it includes technologies that allow the opportunity to mitigate or exploit the aerospace environment for both offensive and defensive operations. Note: In FY 2002, Congress added \$12.8 million (\$8.5 million for the High-frequency Active Auroral Research Program (HAARP) Space Technology, \$2.6 million for HAARP Incoherent Radar, and \$1.7 million for HAARP Electromagnetic Wave Gradiometer). 										
(U) (U)	 <u>FY 2001 (\$ in Thousands</u>) \$2,573 Developed technology to predict space environmental hazards, including solar disturbances and the earth's radiation belts, and the resultant disruptions of operational space systems. This technology leads to improved space system design, lifetime, and operational capabilities and aids in anomaly resolution. Developed technologies that control hazardous space particle populations in extreme environments resulting from natural or adversary actions. Began algorithm development for predicting solar disturbances impacting Air Force systems using all-sky images from new space-based detector system. Developed time-dose probability codes for improved space system design using data from new compact environment anomaly sensors. Began detailed design of active space particle control experiment to demonstrate the feasibility of 										
(U) (U)	\$9,171 \$4,159	 Provide a space-based mitigation technologies. Developed real-time infrared background clutter code, target detection techniques, and decision aids for application to space-based surveillance, laser weapons, and countermeasure systems, including detection of low-observable targets. Validated all-altitude background clutter prediction code through the use of space-based sensor data. Completed deployment aids and performance prediction models that minimize the operational impacts of atmospheric optical turbulence on laser weapons. Completed an assessment of advanced missile detection technologies that provide for the earliest detection of theater ballistic missiles in boost phase. Developed artificial intelligence techniques, forecasting tools, and sensors for improved ionospheric specification and forecasting, including communications/navigation outage forecasting and space-based geolocation demonstrations. Communications/navigation outage forecasting 									
Ρ	roject 1010	will provide the warfighter wi	ith situation:	al awareness Page	and will per 3 of 18 Pag	mit operator	rs to use alte	rnate links o	r systems in Ex	times of out	ages. (PE 0602601F)

	RDT&	DATE February 2002							
BUDO 02 -	GET ACTIVITY - Applied Resea	ch PE	NUMBER AND TITLE 02601F Space Technology	PROJECT 1010					
(U)	A. Mission Descript	on Continued							
(U)	FY 2001 (\$ in Thous	<u>unds) Continued</u> Completed the fabrication and test of instrumentation for c	ommunication/navigation outage forecasting syste	m demonstration. Developed					
(U)	\$1,587	algorithms for correcting ionospheric effects on geolocation Developed key satellite threat warning technologies and to intentional and unintentional ground-based radio frequency have increased knowledge of possible hostile acts directed satellite protection technologies, such as geolocation algor	n accuracy. ols for on-board satellite use that detect, geolocate and laser signals. Satellite threat warning techno at mission critical satellites and aid in satellite and thms, radio frequency antennas, and miniaturized	, and characterize acquired logies enable the warfighter to omaly resolution. Designed key sensor and processing electronics,					
(U)	\$6,772	Expanded experimental research capabilities to characteriz waves at the High Frequency Active Auroral Research Pro underground structures and provide new radio-wave propa collection of diagnostic data to characterize the space weat Frequency virtual antenna properties. Expanded the high f	e and control the physical processes produced in s gram Alaska facility. Continued to further develo gation modes via the generation of irregularities in her environment. Investigated ionospheric Extrem requency radio transmitter capability from 8-MHz	pace with very high power radio p and test concepts for imaging the ionosphere. Continued the hely Low Frequency/Very Low to 10-MHz. Extended roads and					
(U)	\$2,902	Developed technologies that improve the survivability of s and space radiation environment. Expanded the coverage of for predicting the effects of ionospheric scintillation on con- detect hazards to spacecraft from space particles and chem real-time monitoring of solar activity and improved predic	pace systems by specifying, forecasting, and mitig of the Scintillation Network Decision Aid, which i nmunication and navigation systems. Developed ical contamination. Developed advanced instrume tion of space environmental hazards.	ating the effects of the ionosphere s a component of a global system advanced, space-borne sensors to entation and analysis techniques for					
(U)	\$27,164	Total	I I I I I I I I I I I I I I I I I I I						
(U)	FY 2002 (\$ in Thous	unds)							
(U)	(U) \$2,469 Develop technologies for monitoring, predicting, and controlling space environmental conditions hazardous to DoD operational space systems. These technologies lead to improved space system design, lifetime, and operational capabilities and aid in anomaly resolution. Use simulation to assess technologies that control hazardous space particle populations in extreme environments resulting from natural or adversarial actions. Use all-sky images from space-based detector system to develop advanced algorithms for tracking system-impacting solar eruptions en route t Earth. Develop algorithms for short-term forecasting of solar flares, based on observations of plasma flow in solar active regions. Validate time-dose probability codes for space system design using data from compact environment anomaly sensors. Complete design of space partic								
P	Project 1010	Page 4 of	18 Pages	Exhibit R-2A (PE 0602601F)					
		18	32						
	RDT&E	DATE February 2002							
---------------------	----------------------------------	---	--	---					
вирс 02 -	GET ACTIVITY - Applied Resear	PROJECT 1010							
(U)	A. Mission Descripti	on Continued							
(U)	FY 2002 (\$ in Thousa	nds) Continued							
(U)	\$8,251	control experiment. Construct dynamic radiation bell of Develop real-time infrared backgrounds clutter code, sp to space-based surveillance, laser weapons, and counter increased surveillance capability and to more effective specification model and dim-target detection technique all-altitude background prediction code and validate mo for earliest detection of theater ballistic missiles in boo effects on laser weapon system performance. Validate develop a modeling and simulation capability to predic conditions.	lata assimilation and forecast models to predict energy pectral signature libraries, target detection techniques rmeasure systems, including detection of low-observatory operation of laser weapons and countermeasures systent s for advanced space-based surveillance systems. Included with space-based data. Conduct field measurem st phase. Test and validate decision aids and perform global spectral signature libraries created from collect t the performance of surveillance functions under spe	and decision aids for application able targets. Technologies lead to ems. Develop global clutter corporate global clutter model into ents to validate candidate concepts ance prediction tools for turbulence ted hyperspectral imaging data, and cified scene and atmospheric					
(U)	\$6,280	Develop artificial intelligence techniques, forecasting to communications/navigation outage forecasting and spa warfighter through situational awareness, allowing ope suite of ionospheric specification and forecast models for Concept Technology Demonstration. Assemble the mo- navigation reliability maps for geolocation requirement to provide worldwide outage specification and enhance formation and motion of polar ionospheric patches	ools, and sensors for improved ionospheric specificat ce-based geolocation demonstrations. This forecastin rators to use alternate links or systems in times of out for the Communications/Navigation Outage Forecast odels with data-handling systems to construct the C/N ts. Expand the ground-based network of ultra high fre- te the ground-based component of C/NOFS. Establish	ion and forecasting, including og capability will support the ages. Integrate and validate the System (C/NOFS) Advanced OFS data center. Provide equency and L-band satellite links high latitude sites to monitor					
(U)	\$1,387	Develop key satellite threat warning technologies and t intentional and unintentional ground-based radio freque increase knowledge of possible hostile acts directed at miniaturization of radio frequency attack reporting rece software. Investigate integrated attack reporting approx	ools for on-board satellite use that detect, geolocate, a ency and laser signals. Satellite threat warning technomission critical satellites and aid in satellite anomaly eiver. Incorporate results of attack reporting space fli- aches.	and characterize acquired ologies enable the warfighter to resolution. Complete ght test into system hardware and					
(U)	\$8,418	Continue development of the High Frequency Active A infrastructure. Install a permanent aircraft alert radar, a enhancements, and diesel power-plant reliability impro programs to assess the viability of exploiting Extremely	Auroral Research Program (HAARP) site transmitting a Very High Frequency ionosphere radio diagnostic, h vements. Provide facility management and environm y Low Frequency/Very Low Frequency waves genera	and diagnostic instrument high frequency transmitter nental oversight. Conduct research ted in the ionosphere for detecting					
Р	Project 1010	Page	5 of 18 Pages	Exhibit R-2A (PE 0602601F)					
			183						

	RDT&	DATE February 2002		
BUD0 02 -	GET ACTIVITY	PE NUMBER AND TITLE	Technology	PROJECT 1010
(U)	A. Mission Descrip	ion Continued		
(U)	FY 2002 (\$ in Thous	ands) Continued and characterizing underground structures and for reducing charged particle popu	lations in the radiation belts	s, which disrupt satellite systems
(U)	\$2,575	Develop a modular design and phased approach for an Incoherent Scatter Radar (the site infrastructure, including a gravel pad, access road, and power and optical Scatter Radar transmitting modules for engineering test purposes to validate the o	ISR) diagnostic capability f fiber distribution networks. overall concept and design.	or the HAARP facility. Prepare Acquire and install Incoherent
(U)	\$1,683	Investigate, enhance, and test electromagnetic radiometry technologies for the det Active Auroral Research Program facility. Develop a miniature, rugged man-por including improved detection algorithms, frequency agility, and remote data acce- array detection system to exploit emerging technology.	tection of underground struct table hardware system and a ss. Conduct a study for a gr	tures using the High Frequency an experimental airborne system, round-based, unmanned random
(U)	\$31,063	Total		
(U)	FY 2003 (\$ in Thous	ands)		
(U)	\$1,364	Develop technologies for monitoring, predicting, and controlling space environme operational space systems. Validate algorithms for tracking solar plasma clouds t systems. Develop models and algorithms for propagation of solar/geomagnetic ac Complete initial dynamic radiation belt model with real-time data assimilation for	ental conditions hazardous t to Earth and predicting onse ctivity for spacecraft suscep r spacecraft hazard forecast	to Department of Defense (DoD) to the of adverse effects on DoD outbility to single event upsets.
(U)	\$4,716	Develop real-time infrared backgrounds clutter code, spectral signature libraries, to space-based surveillance, laser weapons, and countermeasure systems, includir models with new experimental data and apply to surveillance system design trade determine trade space for space system for earliest detection of theater ballistic m turbulence sources and improve laser weapon performance prediction model of ai techniques to exploit hyperspectral data and validate hyperspectral performance m for space-based sensor to obtain sub-meter, high spectral resolution measurement operational surveillance, target identification, and damage assessment systems.	target detection techniques, 1g detection of low-observal 2s and performance analyses 2issiles in boost phase. Upg 2irborne and space-based sys 2isodeling and simulation coo 2s of optical/infrared backgro	and decision aids for application ble targets. Validate background . From field measurements rade models of atmospheric tems. Develop advanced des. Develop design requirements bunds for next-generation
(U)	\$5,858	Develop artificial intelligence techniques, forecasting tools, and sensors for impro communications/navigation outage forecasting and space-based geolocation demo architecture for collecting and analyzing ground and space data to provide near-re	oved ionospheric specification onstrations. Develop data p eal-time nowcasts and forec	on and forecasting, including rocessing software and hardware asts of ionospheric hazards.
Р	Project 1010	Page 6 of 18 Pages		Exhibit R-2A (PE 0602601F)
		184		

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) DATE February 2002								
BUDO 02 -	GET ACTIVITY • Applied Researc	PROJECT Dy 1010							
(U)	A. Mission Description	<u>a Continued</u>							
(U) (U)	FY 2003 (\$ in Thousan 1 \$ \$11,938	ds) Continued Validate nowcast and forecast predi eduction. Improve techniques to t pecification in high latitude theater Fotal	ctions using ground and space-based experimental database rack the motion of the highly structured plasma in the polar rs. Develop multi-scale algorithms to increase reliability of	es and incorporate results into forecast tool risk region, to enhance the reliability of ionospheric global ionospheric forecasts.					
(U)	<u>B. Project Change Sun</u> Not Applicable.	nmary							
(U) (U) (U) (U) (U) (U) (U)	C. Other Program Fun Related Activities: PE 0305160F, Defense PE 0601102F, Defense PE 0602204F, Aerospac PE 0305111F, Weather This project has been co	Ading Summary (\$ in Thousands) Meteorological Satellite Program. Research Sciences. The Sensors. Systems. Ordinated through the Reliance pro	cess to harmonize efforts and eliminate duplication.						
(U)	D. Acquisition Strateg Not Applicable.	Z							
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.								
Р	roject 1010		Page 7 of 18 Pages	Exhibit R-2A (PE 0602601F)					

	RDT&	E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	iry 2002
BUDO 02 -	ET ACTIVITY Applied Resear	rch			PE NUMBE	R AND TITLE	e Techno	ology			PROJECT 4846
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4846	Spacecraft Payloac	1 Technologies	8,057	14,777	10,631	9,900	13,973	14,321	14,709	Continuing	TBD
(U)	J) <u>A. Mission Description</u> This project develops advanced technologies that enhance spacecraft payload operations by improving component and subsystem capabilities. The project focuses on three primary areas: (1) the development of advanced, space-qualified, survivable electronics, and electronics packaging technologies; (2) development of advanced space data generation and exploitation technologies, including infrared, Fourier Transform hyperspectral imaging, polarimetric sensing, and satellite antenna subsystem technologies; and (3) development of high-fidelity space simulation models that support space-based surveillance and space asset protection research and development for the warfighter. Note: In FY 2002, Congress added \$3.1 million (\$1.3 million for Mixed Signal Very Large Scale Integrated (Circuits) for Space Vehicle Communication Subsystems and \$1.8 million for Satellite Simulation Tool Kit).										
(U) (U)	 Vehicle Communication Subsystems and \$1.8 million for Satellite Simulation Tool Kit). <u>FY 2001 (\$ in Thousands</u>) \$2,351 Developed advanced space infrared technologies, hardened focal plane detector arrays, and quantum well infrared photodetectors (QWIPs) to enable acquisition, tracking, and discrimination of hot targets, as well as 'cold body' targets such as decoys, satellites, and midcourse warheads. Designed low temperature multi-color and low background infrared detectors and QWIPs, higher temperature infrared detectors, and higher performance radiation-hardened detectors. Continued experimental investigation of two-, three-, and multi-color detectors, and tunable and broadband gratings. Investigated future concepts for longer wavelength infrared detectors, mid-wavelength infrared detectors for higher temperature operation, and infrared detectors with optimal background-limited performance for stressing, low photon noise, and space 										
(U)	 \$666 Developed hyperspectral imaging data exploitation methodologies for military remote sensing applications with the Fourier Transform HyperSpectral Imager (FTHSI). The FTHSI payload demonstrated the capability of providing the warfighter data concerning terrain categorization, feature extraction, geological formation mapping, and trafficability within an area observed from space. Completed analysis of the hyperspectral imaging data received from the FTHSI payload. Completed assembly of data images for target identification and image 										
(U)	\$3,859	Developed technologies for sp micro-electro-mechanical sys are decreased feature size, im microelectronic materials and	pace-based p tem devices proved scala internal stru	payload com and advanc bility, decre actures and a	ponents such ed electronic ased size/we apply results	n as low pow cs packaging eight/power, to improve f	ver, high per g for next gen and radiatio fabrication p	formance, ra neration high n-hardness. processes. D	diation-hard performan Continued esigned nex	lened electro ce space elec characterizin t-generation	nic devices, tronics. Goals g low-power,
Р	roject 4846			Page	8 of 18 Pag	es			E>	hibit R-2A	(PE 0602601F)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)							
budo 02 -	GET ACTIVITY • Applied Resear	PROJECT 4846					
(U)	A. Mission Descripti	on Continued					
(U)	FY 2001 (\$ in Thousa	nds) Continued quantum-sized devices such as h radiation-hardened nonvolatile n density, low-power micro-electro power electronics packaging.	igh-speed, radiation-hardened, low-power alternatives for space app nemories, Fast Fourier Transform processors, optical sensors, and ar o-mechanical system (MEMS) device for evaluation in space enviro	plications. Fabricated improved nalog devices. Fabricated ultra-high nment. Fabricated smaller, lighter, lower			
(U)	\$1,181	Developed modeling, simulation large deployable space optics, an systems engineering level technol system test beds. Integrated simu- fidelity of satellite constellation- simulation software into one fran Total	and analysis (MS&A) tools for space-based surveillance systems, and distributed satellite architecture payloads. MS&A tools provide of alogy trade off decisions for space-based missions/campaign level as ulation architecture models using visual programming codes and co level modeling. Interconnected satellite toolkit, spacecraft simulation mework. Evaluated multi-satellite constellations and distributed sate	optical/infrared imaging space systems, data to validate research and development ssessments and for intelligent satellite mmercial-off-the-shelf software to enhance on toolkit, and weather and space ellite cluster models in simulation test bed.			
(\mathbf{U})	φο,037 EV 2002 (\$ in Thouse	nds)					
(U) (U)	\$4,386	Develop advanced infrared device tracking, and discrimination of ta read-out devices that will perform both broadband and narrow band for multi-band (two- and three-co radiation-hardness, radiation tole detection requirements for space	the technologies for space applications that support hardened focal plargets such as decoys, satellites, and warheads, throughout their trajers in for extended periods of time under adverse natural and enhanced a detector devices and the appropriate low-noise, cryogenic read-out olor) detection. Enhance device architectures for future space sense erance, longer wavelengths, higher operating temperatures and higher, and explore and exploit potential infrared device solutions.	ane detector arrays to enable acquisition, ectory. Develop cryogenic detector and space environments. Develop and evaluate device and device architectures necessary or concepts that include the need for er frame rates. Study next generation			
(U)	\$985	Develop hyperspectral imaging of HyperSpectral Imager (FTHSI) a sensor systems by improving the hyperspectral imaging system per understanding the electro-optical	data exploitation methodologies for military imaging and remote ser and polarimetric sensing technologies will provide enhanced surveil ability of the systems to discriminate military targets in various sce erformance based on data received from the FTHSI payload. Develo	nsing applications. Fourier Transform lance capability for future space-based enarios. Complete evaluation of the op technology and modeling for			
(U)	\$4,388	Develop technologies for space- MEMS devices, and advanced el	based payload components such as low power, high performance, ra ectronics packaging for next generation high performance space ele	adiation-hardened electronic devices, ectronics. Expand microelectronic material			
Р	roject 4846		Page 9 of 18 Pages	Exhibit R-2A (PE 0602601F)			

	RDT&E	Exhibit)	DATE February 2002							
BUDO 02 -	GET ACTIVITY - Applied Resear	PROJECT 4846								
(U)	A. Mission Descripti	on Continued								
(U)) <u>FY 2002 (\$ in Thousands) Continued</u> characterization to silicon-on-insulator and chalcogenide materials and apply radiation research and material defect analysis to improve device design. Fabricate and test monolithically integrated low power, silicon-based quantum-sized devices. Characterize new radiation-hardened nonvolatile digital memories, Fast Fourier Transform (FFT) processors, and optical sensors. Investigate design enhancements for ten-fold performance improvement for the memories and FFT processors. Fabricate nonvolatile analog memories. Establish a micro-electro-mechanical (MEMS) reliability test device for ground and space experiments. Investigate a chip-scale packaging system with									
(U)	\$963	Develop modeling, simulation, and analysis tools for space-based surveilla imaging space systems, large deployable space optics, and distributed sate and spacecraft simulation toolkit. Extend simulation architecture to suppor flight test experiment.	ince systems, rendezvous and proxi llite architecture payloads. Comple rt flight software development and	mity operations, optical/infrared ete connection of satellite toolkit definition and conduct near-term						
(U)	\$985	Develop advanced satellite antenna architectures and performance charact advanced antenna architectures will improve the affordability and capabilit surveillance and navigation efforts. Develop algorithms for performance of engineering models to simulate performance of phased-array antenna tiles for phase control. Characterize performance of antenna tiles and modules actual performance. Extend engineering models to simulate performance preparation for demonstration on a three microsatellite constellation space	erization tools for large, lightweigh ty of antennas for space-based payl characterization of modular phased- and integrated antenna modules to and correlate results to model predi- of the antenna tiles and integrated n flight experiment	t, modular space antennas. The oad subsystems for Air Force array antenna tiles. Build and test include MEMS time delay units actions; update models based on nodules in a space environment in						
(U)	\$1,783	Develop core infrastructure components for a robust satellite simulation of the technology programs via modeling and simulation of all phases from concept programs and build software components for different user interfaces, conner and installation on inexpensive computer platforms. Add models and simulation and remote inspection sensors. Develop requirements for and initial design counterspace technologies to be used for concept studies.	olkit. The toolkit will enable cost- ept design through flight experimen ction to external hardware/software ilations of such space-based payloa ns of high-level models of space ca	effective risk reduction for space and technology transition. environments and simulations, d systems as radar, hyperspectral, pability protection and						
(U)	\$1,287	Develop radiation-hard analog for mixed signal, Very Large Scale Integra satellite-ground station communications. Radiation test and characterize s determine feasibility of adapting commercial technologies for military app	ed circuits for secure high-bandwic tate-of-the-art commercial mixed si lication. Design new radiation-har	Ith intra-satellite and ignal systems and elements to d analog elements.						
(U) P	\$14,777 Project 4846	Total Page 10 of 18 Pages		Exhibit R-2A (PE 0602601F)						

	RDT&E	DATE February 2002	
BUD 02 ·	GET ACTIVITY - Applied Resear	PE NUMBER AND TITLE Ch 0602601F Space Technology	PROJECT 4846
(U)	A. Mission Description	on Continued	
(U) (U)	<u>FY 2003 (\$ in Thousa</u> \$3,808	<u>nds</u>) Develop advanced infrared device technologies for space applications that support hardened focal pl tracking, and discrimination of targets such as decoys, satellites, and warheads throughout their traje detector and continue development of multi-color detectors and tunable and broadband gratings. De future longer wavelength infrared detectors and infrared detectors with optimal background-limited noise, and space backgrounds. Complete design study of next generation long and very long wavele quantum wells and strained layer superlattices, as lower cost, higher performance alternatives to mer	ane detector arrays to enable acquisition, ectory. Evaluate two- and three-color sign and fabricate selected concepts for performance for stressing, low photon ength infrared detector concepts, including rcury cadmium telluride. Evaluate
(U)	\$901	delivered radiation-hardened cryogenic multiplexers for lower background, space infrared detector a Develop spectral sensing and data exploitation methodologies for military imaging and remote sensi technology and modeling for understanding the electro-optical/infrared polarimetric phenomenology model capability and validate with measured data. Develop capability to integrate polarimetric mod (MS&A) for space-based surveillance applications	rrays. ng applications. Continue development of 7. Evaluate initial polarimetric signature els into modeling, simulation, and analysis
(U)	\$3,733	Develop technologies for space-based payload components such as low power, high performance, ra micro-electro-mechanical system (MEMS) devices, and advanced electronics packaging for next ger electronics. Continue silicon-on-insulator radiation research and enhance the switching speed and d ten times for improved devices. Extend the design of the monolithically integrated low power, silico non-traditional electronic materials. Continue to improve the speed of the radiation-hardened nonvo analog memories and enhance resolution to an eight-bit equivalent. Build space-qualified MEMS represented and flight insertion.	diation-hardened electronic devices, neration high performance space urability of the chalcogenide material by on-based quantum-sized devices to include platile digital memories. Characterize the eliability test devices and chip-scale
(U)	\$1,189	Develop MS&A tools for space-based surveillance systems, rendezvous and proximity operations, o large deployable space optics, and distributed satellite architecture payloads. Extend simulation arcl ground-to-space segment simulation, post-experiment distributed signal processing, and post-experiment then be used for objective system-of-systems assessment	ptical/infrared imaging space systems, nitecture to support flight experiment ment data validation. The architecture can
(U)	\$1,000	Develop advanced satellite antenna architectures and performance characterization tools for large, li Extend antenna architecture and algorithms developed for performance characterization of modular wide-bandwidth, multi-mode operation to include advanced low-noise amplifiers, integrated wide-b frequency manifold control technologies. Build and test engineering models to simulate performance array antenna tiles and integrated antenna models.	ghtweight, modular space antennas. phased array antenna tiles to multi-beam, andwidth radiators, and active radio e of multi-beam, wide-bandwidth phased
F	Project 4846	Page 11 of 18 Pages	Exhibit R-2A (PE 0602601F)
		189	

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) February 2002									
budg 02 -	ET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT 4846							
(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	A. Mission Description Continued FY 2003 (\$ in Thousands) Continued \$10,631 Total B. Project Change Summary Not Applicable. C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0603401F, Advanced Spacecraft Technology. This project has been coordinated through the Reliance process to harmonize of D. Acquisition Strategy Not Applicable. E. Schedule Profile Not Applicable.	efforts and eliminate duplication.								
Pr	roject 4846 Page	2 of 18 Pages	Exhibit R-2A (PE 0602601F)							

	RDT&	E BUDGET ITEM JU	STIFIC	ATION \$	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
виро 02 -	ET ACTIVITY Applied Resear	ch			PE NUMBE 060260	R AND TITLE	e Techno	ology			PROJECT 5018
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5018	Spacecraft Protection	on Technology	0	0	4,620	3,948	2,552	2,351	2,157	Continuing	TBD
Note	In FY 2003, Project	1010 is split, with efforts focus	ed on protec	ting spacecra	aft from mar	made threat	s being trans	sferred into I	Project 5018		
(U)	<u>A. Mission Description</u> This project develops performance loss in s technologies, and dev	the technologies for protecting upport of warfighter requireme reloping technologies to mitigat	U.S. space nts. The provide the effects	assets in pot oject focuses s of both inte	ential hostile s on identify ntional and	e environment ong and assest unintentiona	nts to assure ssing spacec l threats.	continued s raft system	pace system vulnerabilitie	operation w es, developir	ithout g threat warning
(U) (U) (U)	<u>FY 2001 (\$ in Thousa</u> \$0 \$0	<u>ands)</u> No Activity Total									
(U) (U) (U)	<u>FY 2002 (\$ in Thousa</u> \$0 \$0	ands) No Activity Total									
(U)	FY 2003 (\$ in Thousa	ands)									
(U) (U) (U)	 U) \$1,000 Develop key satellite threat warning technologies and tools for on-board satellite use to detect, geolocate, and characterize intentional and unintentional ground-based radio frequency (RF) and laser signals. Begin development of a high performance multiple threat sensors satellite protection system, improving technical performance of the sensor suite while still minimizing cost, power, and weight. Investigate integration of the miniature radio frequency receiver, laser detector, and ionospheric specification system with advanced reconfigurable processor electronics for the first generation system. Assess feasibility of using a single antenna for performing RF geolocation from a low-earth-orbit satellite. Investigate laser and RF false alarm rejection/mitigation and anomaly resolution and management techniques. U) \$1,395 Develop miniaturized RF attack receiver. Complete post-test data and system performance analysis of risk reduction space experiment. Continue system integration for year-long space flight demonstration of advanced attack reporting system. 										
<-/		currently fielded or launch rea telemetry, state-of-health data	ady satellites	s for prelimin appropriate c	nary determi lata for even	nation of RF t determinat	Vlaser illumi ion. Prepare	ination or kine for laborate	netic impact ory proof of	. Assess the concept dem	use of onstrations.
Р	roject 5018			Page	13 of 18 Pag	ges			Ex	hibit R-2A	PE 0602601F)

	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 2002						
BUDO 02 -	GET ACTIVITY • Applied Research	PROJECT 5018						
(U)	A. Mission Description Continued							
(U) (U)	 J) <u>FY 2003 (\$ in Thousands) Continued</u> J) \$1,857 Develop techniques for monitoring and assessing electromagnetic interference and compatibility between ultra-sensitive payload sensors for space systems which support space weather forecasting. Begin payload integration for the Communications/Navigation Outage Forecast System Advanced Concept Technology Demonstration. Design, develop, and test serial communications hardware and software for command and data handling spacecraft sub-system risk reduction for real-time space weather forecasting. Validate data compression techniques with payload sensor data and apply to space flight software for demonstrating space weather forecasting 							
(U)	\$4,620 Total							
(U)	<u>B. Project Change Summary</u> Not Applicable.							
(U) (U)	C. Other Program Funding Summary (\$ in Thousands) PE 0603401F, Advanced Spacecraft Technology.							
(U)	D. Acquisition Strategy Not Applicable.							
(U) (U)	 J) <u>E. Schedule Profile</u> J) Not Applicable. 							
Ρ	Project 5018 Pa	age 14 of 18 Pages	Exhibit R-2A (PE 0602601F)					

	RDT&I	E BUDGET ITEM JU	STIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUD(02 ·	GET ACTIVITY • Applied Reseat	rch			PE NUMBE 060260	R AND TITLE	e Techno	ology			PROJECT 8809
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
8809	Spacecraft Vehicle	Technologies	31,918	35,504	31,393	35,193	37,619	38,818	39,856	Continuing	TBD
(U)	J) <u>A. Mission Description</u> This project focuses on seven major space technology areas: spacecraft platforms (e.g., structures, controls, power, and thermal management); space-based payloads (e.g., survivable electronics); satellite control (e.g., software for autonomous distributed satellite formation flying, signal processing, and control); modeling and simulation of space-based systems; satellite protection technologies (e.g., space environment effects, debris prediction, and threat warning/attack reporting); microsatellite technologies; and integrated experiments of advanced technologies for transition to planned systems (e.g., payload/platform/launch vehicle merging). Note: In FY 2002, Congress added \$4.7 million (\$3.0 million for Composite Cryogenic Fuel Tanks and \$1.7 million for Terabit).										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$2,990	ands) Continued to develop technol lightweight batteries, and inno power, longer operational life Continued development of 35 electric conversion technolog mechanisms that limit operati	ogies for ad ovative pow times and ir percent effi y and lithiur onal life and	vanced space er generation creased ope cient solar c n ion and po l degrade cry	e platform su n and storage rational rang ells and thin lymer batter vocooler sub	bsystems sub concepts. A e, and will b film solar co ies. Improve system perfo	ich as cryoco Advance spa be lighter and ells. Compl ed accuracy ormance.	oolers, comp ace platform d more affor eted develop of cryocoole	act, high eff subsystems dable than c oment of pov er modeling	iciency solar will have mo urrent subsyster ver cells usir tools, and ide	power cells, pre available stems. ng thermal to entified
(U)	 \$7,104 Continued to develop technologies for advanced space platform structures such as spacecraft structural controls for vibration suppression, multi-functional structures, deployable large aperture optical arrays, and lightweight composite satellite and launch vehicle structures. Whole spacecraft launch vibration suppression will enable precision pointing and sensing systems. Multi-functional and composite structures, with a higher level of integration and standardized interfaces will be reusable, lighter, and more affordable. Developed and completed vibration suppression algorithms. Continued development of multi-functional structures and complete integration techniques. Integrated and ground 						ppression, ctures. Whole ructures, with a l vibration l and ground				
(U)	\$1,552	Continued development of grand standardized interfaces for space and near-space experime operations.	ound support or testing and ents. Condu	t and small s demonstrat ucted Mighty	satellite integ ing revolution ySat II.1 mis	gration techn onary high p sion operation	ayoff missio	spaceborne p n hardware an analyzing	platforms wi and mission platform an	th advanced -enabling tec d stand-alon	bus components hnologies for e experiment
(U)	\$13,695	Continued to develop microsa	tellite (10-1	00kg) techn	ologies and i	ntegrated m	icrosatellite	technology	concepts. Fa	abricated cor	nponents for
F	roject 8809			Page	15 of 18 Pag	ges			Ex	(hidit R-2A	(PE 0602601F)

	RDT&	DATE February 2002				
вирс 02 -	GET ACTIVITY - Applied Resear	PROJECT 8809				
(U)	A. Mission Descript	ion Continued				
(U)	FY 2001 (\$ in Thouse	ands) Continued microsatellite, and completed detailed design of a three-unit flight constellation to demonstrate on-orbit form	nation flying, inter-satellite			
(U)	\$1,741	Developed and demonstrated innovative methodology for aluminum aerostructure design. Developed a tec processing/manufacturing capability into early design and analysis. Identified specific opportunities to emp weapon systems. Demonstrated benefits on selected parts/assemblies to minimize cost while maintaining m	hnical strategy to insert aluminum loy methodology on Air Force lechanical properties.			
(U)	\$967	Developed low-cost, lightweight, leak-proof, linerless, non-metallic composite cryogenic tanks for reusable vehicle applications. Designed, fabricated, and tested lightweight composite end-bosses and performed stud delamination and micro-cracking.	and small expendable launch lies to address problems with			
(U)	 W) \$3,869 With the transmission level U) Further developed and evaluated the world's first optically implemented Code Division Multiple Access wide-band network within the context of the Next Generation Internet. Assessed and demonstrated the inherent security capabilities as a means of enhancing information assurance a the transmission level 					
(U)	\$31,918	Total				
(U)	FY 2002 (\$ in Thous	ands)				
(U)	\$4,386	Develop technologies for advanced space platform subsystems, such as cryocoolers, compact, high-efficience innovative power generation concepts. Continue identification of mechanical mechanisms for assessing cry improved models for low-temperature cryocooler regenerator performance. Complete a 32 percent efficient efficient thin-film solar cell.	cy solar power cells and arrays, and ocooler reliability. Develop c solar cell and a ten percent			
(U)	\$8,877	Develop technologies for advanced space platform structures such as structural controls for vibration suppre deployable large aperture optical arrays, and lightweight composite satellite and launch vehicle structures. O suppression systems. Fabricate and characterize performance of multi-functional structure designs. Continu component subsystems of deployable large aperture optical arrays. Start development of multifunctional bu	ssion, multifunctional structures, Ground test payload vibration are integration and ground test of s structure for small spacecraft.			
(U)	\$150	Complete development of ground support and small satellite integration technologies for spaceborne platfor and standardized interfaces for testing and demonstrating revolutionary high payoff mission hardware and n space and near-space experiments. Complete final analyses and reports on the MightySat II.1 platform and	ms with advanced bus components hission-enabling technologies for stand-alone experiment options.			
(U)	\$17,436	Develop microsatellite (10-100kg) technologies and integrated microsatellite technology concepts. Integrate model, and begin component fabrication of a three-unit flight constellation to demonstrate on-orbit formation	e and test microsatellite engineering n flying, inter-satellite			
Р	Project 8809	Page 16 of 18 Pages	Exhibit R-2A (PE 0602601F)			

	RDT&E	DATE February 2002	
вира 02 -	GET ACTIVITY • Applied Resear	PE NUMBER AND TITLE ch 0602601F Space Technology	PROJECT 8809
(U)	A. Mission Descripti	on Continued	
(U)	FY 2002 (\$ in Thousa	unds) Continued	
(U)	\$2,972	communications, distributed processing, and sparse aperture sensing. Develop low-cost, lightweight, leak-proof, linerless, non-metallic composite cryogenic tanks for reusable and applications. Investigate novel composite material systems and processes, focusing on manufacturability and (LOX) compatible material system, addressing both oxidation and ignition phenomena. Design, fabricate, and	d small expendable launch vehicle d scaling. Develop liquid oxygen nd test full-scale tanks to determine
(U)	\$1,683	the effectiveness of microcrack mitigation and LOX compatibility techniques on flight-representative article. Develop and evaluate the world's first optically implemented Code Division Multiple Access wide-band netw Generation Internet. Continue to assess and demonstrate the inherent security capabilities of different coding information assurance at the transmission level.	s. work within the context of the Next g schema as a means of enhancing
(U)	\$35,504	Total	
(U)	FY 2003 (\$ in Thousa	unds)	
(U)	\$4,688	Develop technologies for advanced space platform subsystems such as cryocoolers, compact, high efficiency innovative power generation concepts. Continue to improve accuracy of cryocooler modeling tools and the initiation operational life and degrade cryocooler subsystem performance. Demonstrate a 35 percent efficient sol capacity for a ten percent efficient thin-film solar cell	v solar power cells and arrays, and identification of mechanisms that lar cell. Demonstrate production
(U)	\$10,963	Develop technologies for advanced space platform structures such as structural controls for vibration suppress deployable large aperture optical arrays, and lightweight composite satellite and launch vehicle structures. F suppression systems. Continue performance characterization of multifunctional hus structure for small space	ssion, multifunctional structures, light test payload vibration
(U)	\$15,742	Develop microsatellite (10-100kg) technologies and integrated microsatellite technology concepts. Integrate microsatellites which will later form a three-flight unit constellation to demonstrate on-orbit formation flying distributed processing, and sparse aperture sensing.	and functionally test three g, inter-satellite communications,
(U)	\$31,393	Total	
(U)	<u>B. Project Change S</u> Not Applicable.	ummary	
Р	roject 8809	Page 17 of 18 Pages	Exhibit R-2A (PE 0602601F)
		105	

RDT&E BUDGET ITEM JUST	DATE February 2002	
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT 8809
 (U) <u>C. Other Program Funding Summary (\$ in Thousands</u> (U) Related Activities: (U) PE 0602203F, Aerospace Propulsion. (U) PE 0602102F, Materials. (U) PE 0603311F, Ballistic Missile Technology. (U) PE 0603401F, Advanced Spacecraft Technology. (U) PE 0603500F, Multi-Disciplinary Advanced Development (U) This project has been coordinated through the Reliance propulation. 	s) at Space Technology rocess to harmonize efforts and eliminate duplication.	
(U) D. Acquisition Strategy Not Applicable.		
 (U) <u>E. Schedule Profile</u> (U) Not Applicable. 		
Project 8809	Page 18 of 18 Pages	Exhibit R-2A (PE 0602601F)
	196	

PE TITLE: Conventional Munitions

	RDT&E BUDGET ITEM J	USTIFIC	CATION	SHEET	(R-2 E)	chibit)		DATE	Februa	ıry 2002
BUDO 02 -	GET ACTIVITY • Applied Research			PE NUMBE 060260	R AND TITLE	entional	Munitior	IS		
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	51,474	49,029	60,343	52,709	54,210	55,489	56,767	Continuing	TBD
2068	Advanced Guidance Technology	0	16,667	18,048	18,156	18,716	19,155	19,795	Continuing	TBD
2502	Ordnance Technology	51,474	32,362	42,295	34,553	35,494	36,334	36,972	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0
techr	A. Mission Description This program investigates, develops, and establishes air-launched munitions. The program includes two detection and identification algorithms, and simulati explosives, munitions integration, and weapon letha	the technica projects: (1) on assessme lity and vuln	al feasibility developmen nts; and (2) erability ass	and military t of advance developmen essments.	y utility of ad ad guidance t t of conventi	lvanced guid technologies	ance and ord including se ce technolog	lnance techr ekers, navig ies includin	nologies for o gation and co g warheads,	conventional introl, target fuzes,
(U)	<u>B. Budget Activity Justification</u> This Program is in Budget Activity 2, Applied Researevolutionary technologies.	arch, since it	develops an	d determine	s the technic	cal feasibility	and militar	y utility of e	volutionary	and
(U) (U) (U) (U)	C. Program Change Summary (\$ in Thousands) Previous President's Budget Appropriated Value Adjustments to Appropriated Value a. Congressional/General Reductions				<u>FY 200</u> 52,734 53,223	<u>)1 F</u> 4 3	<u>EY 2002</u> 49,270 49,270 -241	<u>FY 200</u> 49,79	<u>03</u> 98	<u>Total Cost</u>
			Page	1 of 13 Pag	es			E	Exhibit R-2	(PE 0602602F)
				197						

	RDT&E BUDGET ITEM JUSTIFICATIO	DATE Februa	DATE February 2002			
вира 02 -	SET ACTIVITY - Applied Research	onal Munition	IS			
(U)	C. Program Change Summary (\$ in Thousands) Continued					
	 b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram d. Palow Threshold Paprogram 		<u>FY 2001</u> -1,260	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>
(U)	e. Rescissions Adjustments to Budget Years Since FY 2002 PBR		-489		10,545	
(U)	Current Budget Submit/FY 2003 PBR		51,474	49,029	60,343	TBD
	P ₂	age 2 of 13 Pages			Exhibit R-2	(PE 0602602F)

	RDT&	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDO 02 -	BET ACTIVITY Applied Resear	ch			PE NUMBE 060260	r and title 2F Conv	entional	Munitior	IS		PROJECT 2068
COST (\$ in Thousands) FY 2001 FY 2002 Actual Estimate					FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2068	Advanced Guidanc	e Technology	0	16,667	18,048	18,156	18,716	19,155	19,795	Continuing	
Note: (U)	 ote: In FY 2001, Project 2068 was combined with 2502. In FY 2002, Project 2068 was separated from 2502 for clarity of describing the different technologies. J) <u>A. Mission Description</u> This project investigates, develops, and evaluates conventional munitions advanced guidance technologies to establish technical feasibility and military utility. This project includes development of advanced guidance including terminal seekers, navigation and control, signal and processing algorithms, and guidance and control simulations. Project payoffs include: adverse-weather and autonomous precision guidance capability; increased number of kills per sortie; increased aerospace vehicle survivability improved reliability and affordability; and improved survivability and effectiveness of conventional weapons. 					logies. y utility. This e and control erospace vehicle					
(U) (U) (U)	<u>FY 2001 (\$ in Thousa</u> \$0 \$0	<u>ands)</u> This work was performed in I Total	Project 2502								
(U) (U)	<u>FY 2002 (\$ in Thous</u> \$5,733 \$4,782	ands) Investigate and develop advan signal pre-processing, target r enhanced precision, adverse v next generation seekers that v software tools for the develop Initiate development and grou DARPA, investigate and develop advan rejection modules, detection a will allow a more efficient fli and fabricate a reliable, accur environments in the presence device, based on micro-electr	nced guidand recognition, a weather, and will increase oment of lase and test of a elop focal pla nced navigat and segmenta ght path to th ate, miniatur of Global Pe omechanical	ce component spatial targe autonomous a weapon's le r radar algo scanner-less ane array are ion and com- ation module the target, ind rized, and lo ositioning Sy l system tech	nt technologi t characterist s seekers for kill probabili rithms and c claser radar s chitecture ca trol technolo es, and micro crease stando w-cost anti-j ystem (GPS) mology, whi	tics, optics, a air-delivered ity, reduce per reate a datab system with pable of flas gies, for exa p-electromeco off ranges, ar am weapon jamming sy the couples t	aser sources, and beam sca d munitions. ilot workload base for both simultaneou h (one shot) mple nonlin chanical gyro nd enhance s guidance systems. Com he GPS sign	detectors an anning and s These tech d, and enhan measured an s, multi-wav range imagi ear controlle os for air-del trike aircraft stem capable aplete applie al with an in	ad detector a haping techn nologies wil ce sortie eff nd synthetic relength cap ng for applie ers, biomime ivered muni t effectivene e of operatin d research o pertial naviga	rrays, receivent nology for lo l enable the e ectiveness. It laser radar in abilities. In e cation in lase stic guidance tions. These ss and surviv g in highly d f a miniature ation system	er electronics, wer cost, development of Develop nformation. conjunction with er radar seekers. , clutter technologies vability. Design ynamic flight navigation to provide
Р	roject 2068			Page	3 of 13 Pag	es			Ex	hibit R-2A ((PE 0602602F)
					199						

	RDT&E	BUDGET ITEM JUSTIFICATION	SHEET (R-2A Exhibit)	DATE February 2002			
виро 02 -	GET ACTIVITY - Applied Resear	ch	PE NUMBER AND TITLE 0602602F Conventional Munitions	PROJECT 2068			
(U)	A. Mission Descripti	on Continued					
(U)	FY 2002 (\$ in Thousa	nds) Continued ultra-high GPS jamming resistance and accuracy wi	thout the need for an anti-jam antenna.				
(U)	\$3,095 Investigate and develop advanced optical and digital processors and target detection, classification, and identification algorithms for improved seeker performance to allow greater air-delivered weapon autonomy. These seekers will deny an enemy the ability to hide or camouflage a target while also decreasing the pilot's workload. Develop an in-house, state-of-the-art signal and imaging processing capability used to assess current and future, single-mode, ultra-spectral, and multi-mode seeker concepts. Investigate and transition biomimetic principles and concepts, including foveal vision and neuromorphic imaging systems, into advanced seeker components for moving target scenarios. Continue in-house activities including algorithms and simulation development and validation, statistical analysis of fixed, mobile targets, and background data, independent evaluation of target classification software, pattern recognition concepts, and seeker processing techniques to support design of						
(U) (U)	\$3,057 \$16,667	Investigate and develop detailed six-degree-of-freed target recognition, and biomimetic processing. Sim to analyze guided munitions and their components t reduction. These simulations will shorten developm analysis efforts and multi-sensor modeling to impro cycle expense for state-of-the-art seekers. Develop will combine optical signals to produce a complex 1 seeker components. Develop six-degree-of-freedom technology for guided weapon systems. Develop m planned, and conceptual munitions to identify high p Total	dom and hardware-in-the-loop simulations including synt ulations also include trajectory optimization algorithm and hat will enable requirement studies, design iteration and nent time, reduce development cost, and provide more effi- ve target signature prediction models, expedite developm hardware-in-the-loop, laser radar, scene projector instrur aser radar return signal capable of providing real-time sc in simulations to provide detailed performance estimates of rodular system level analysis tools to provide comprehen- payoff technologies and weapon attributes.	hetic aperture radar, automatic ad polarization sensing and models evaluation, and experiment risk fective munitions. Continue nent, and reduce the acquisition nentation. The instrumentation ene generation capabilities to test of guidance related component sive comparisons among inventory,			
(L)	FY 2003 (\$ in Thousa	nds)					
(U)	\$6,774	Investigate and develop advanced guidance comport such as laser sources, detectors and detector arrays, optics, and low-cost beam scanning and shaping tec will increase a weapon's kill probability, reduce pilo parallel processing target acquisition algorithms. Ex-	nent technologies for adverse weather, and autonomous sureceiver electronics, signal pre-processing, target recogn hnologies. These technologies will enable the developm of workload, and enhance sortie effectiveness. Demonstr valuate laser radar components to quantify operational ratio.	eekers for air-delivered munitions, ition, spatial target characteristics, ent of next generation seekers that ate in-house, high-throughput, nge, target detection and			
F	Project 2068	Pa	ge 4 of 13 Pages	Exhibit R-2A (PE 0602602F)			
			200				

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2002
BUDO 02 -	GET ACTIVITY - Applied Resear	ch PE NUMBER AND TITLE 0602602F Conventional	Munitions	PROJECT 2068
(U)	A. Mission Description	on Continued		
(U)	FY 2003 (\$ in Thousa	nds) Continued identification, aim-point selection, and weather penetration effectiveness. Develop a low-c	cost, synthetic aper	rture radar seeker to assess future
(U)	\$4,803	Investigate and develop advanced navigation and control technologies for air-delivered mu biomimetic guidance, clutter rejection modules, detection and segmentation modules, and re will allow a more efficient flight path to the target, increase standoff ranges, and enhance s Complete laboratory field testing of a reliable, accurate, miniaturized, and low-cost anti-jan will be capable of operating in highly dynamic flight environments in the presence of Glob new design technologies for tactical munitions flight control systems. Develop novel ways higher levels of integration of guidance, navigation, control, and estimation algorithms. In applications to guidance. Investigate clutter and mult-discriminate rejection to defeat came	initions, for instant micro-electromech trike aircraft effect m weapon guidanc oal Positioning Sys s to enhance weapon westigate the neuro ouflage, concealm	ce nonlinear controllers, nanical gyros. These technologies tiveness and survivability. ce system. This guidance system atem jamming devices. Develop on system effectiveness through o-physiology of insects for ent, and deception.
(U)	\$3,308	Investigate and develop advanced optical and digital processors and target detection, classi seeker performance to allow greater air-delivered weapon autonomy. These seekers will d target while also decreasing the pilot's workload. Develop highly innovative concepts and investigating biomimetic principles and concepts, including foveal vision and neuromorphi moving target scenarios. Investigate algorithms to perform flight trajectory shaping that re	fication, and ident eny an enemy the approaches in guid ic imaging system educe manning effo	ification algorithms for improved ability to hide or camouflage a dance and control. Continue s, for use in advanced seekers for ects.
(U)	\$3,163	Investigate and develop detailed six-degree-of-freedom and hardware-in-the-loop simulation target recognition, and biomimetic processing. Technologies also include trajectory optime models to analyze guided munitions and their components that will enable requirement stur- risk reduction. These simulations will shorten development time, reduce development cost analysis efforts and multi-sensor modeling to improve target signature prediction models, e- cycle expense for state-of-the-art seekers. Investigate the long-term technology and strateg projector. Develop two-dimensional laser arrays for laser radar scene projectors. Provide component technology, using six-degree-of-freedom simulations, for guided weapon syster analysis tools to provide comprehensive comparisons among inventory, planned, and conce technologies and weapon attributes.	ons including syntl ization algorithm, dies, design iteration t, and provide more expedite developm gy for developing a detailed performant ms. Continue to d eptual munitions to	netic aperture radar, automatic and polarization sensing and on and evaluation, and experiment e effective munitions. Continue ent, and reduce the acquisition an advanced laser radar scene nce estimates of guidance-related evelop modular, system-level, o identify high pay-off
(U)	\$18,048	Total		
Р	Project 2068	Page 5 of 13 Pages		Exhibit R-2A (PE 0602602F)
		201		

	RDT&E BUDGET ITEM JUSTIFICATION	SHEET (R-2A Exhibit)	DATE February 2002
BUD 02 -	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions	PROJECT 2068
(U)	<u>B. Project Change Summary</u> Not Applicable.		
(U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0603601F, Conventional Weapons Technology. This project has been coordinated through the Reliance process to harmoniz	e efforts and eliminate duplication.	
(U)	D. Acquisition Strategy Not Applicable.		
(U) (U)	E. Schedule Profile Not Applicable.		
F	Project 2068 Pag	e 6 of 13 Pages	Exhibit R-2A (PE 0602602F)
		202	

BUDGET ACTIVITY PENUMBER AND TTILE PROJECT 02 - Applied Research 0202602 FCONVENTIONAL MUNITORS 2502 COST (§ in Thousands) FY 2001 FY 2002 FY 2003 FY 2003 FY 2003 FY 2004 FY 2005 FY 2006 FY 2006 FY 2007 Cost in Complete Total Cost 2502 Ordnance Technology 51.474 32.362 42.955 34.553 35.494 36.372 Continuing Total Cost 2502 Ordnance Technology 51.474 32.362 42.955 34.553 35.494 36.372 Continuing Total Cost 10 Mission Description This project investigates, develops, and evaluates conventional ordnance technologies to estabilist tochnical ficasibility and military utility. Included in this project are technology forgrams and assesses target vulnerability. The payoffs include: improved starge capability and transportation safety of fully assembled weapons; improved warhead and fize effectiveness; improved warhead and fize effectiveness; improved warhead and fize effectiveness; interproved warhead setimation safety of fully analytical tools such as computational mechanics models for predicting weapons effects and assessing target vulnerability. These analysis tools reduced warhead developement time and cast, thereby providing more effective massio to the Ari Force. Investigated and d		RDT&	E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
COST (\$ in Thousands) FY 2001 Actual FY 2002 Estimate FY 2003 Estimate FY 2005 Estimate FY 2006 Estimate FY 2007 Estimate Cost to Estimate Cost to Estimate <thcost to<br="">Estimat</thcost>	BUDO 02 -	BET ACTIVITY Applied Resea	ırch			PE NUMBE	r and title 2F Conv	entional	Munitior	าร		PROJECT 2502
2502 Ordnance Technology 51,474 32.362 42.295 34,563 35,494 36,334 36,972 Continuin Note: In FY 2001, Project 2068 was combined with 2502. In FY 2002, Project 2068 was separated from 2502 for clarity of describing the different technologies. (U) A.Mission Description This project investigates, develops, and evaluates conventional ordnance technologies to establish technical feasibility and military utility. Included in this project are technology. The project also assesses the lethality and ffectiveness of current and planned conventional weapons iterhnology programs and assesses target vulnerability. The payoffs include: improved storage capability and transportation safet y of fully assembled weapons; improved warhead and fuze effectiveness; improved submunition dispensing; low-cost airframe/subsystem components and structures; and, reduced aerospace vehicle/weapon's drag. (U) FY 2001 (S in Thousands) (U) \$6,736 Investigated and developed high fidelity analytical tools such as computational mechanics models for predicting weapons effects and assessing target vulnerability. These analysis tools reduced warhead development time and cost, thereby providing more effective model, including models of geological structures, involved in predicting penetrator performance against hard targets. Investigated innovative kill mechanisms for defeating weapons of mass destruction. Transitioned selected high fidelity analytical tools to weapon designers, DOJ, and industry. (U) \$3,316 Investigated and developeed nore efficient affordable explosives including		COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Note: In FY 2001, Project 2068 was combined with 2502. In FY 2002, Project 2068 was separated from 2502 for clarity of describing the different technologies. (U) A. Mission Description This project investigates, develops, and evaluates conventional ordnance technologies to establish technical feasibility and military utility. Included in this project are technology. The project also assesses the lethality and effectiveness of current and planned conventional weapons technology programs and assesses target vulnerability. The payoffs include: improved storage capability and transportation safety of fully assembled weapons; improved warhead and fuze effectiveness; improved submunition dispensing; low-cost airframe/subsystem components and structures; and, reduced aerospace vehicle/weapon's drag. (U) FY 2001 (\$ in Thousands) (U) S6.736 Investigated and developed high fidelity analytical tools such as computational mechanics models for predicting weapons effects and assessing target vulnerability. These analysis tools reduced warhead development time and cost, thereby providing more effective munitions to the Air Force. Investigated and developed more efficient affordable explosives including inert dense metal additives, strugstave, and nano-scale and thard targets. Investigated index evoloped more efficient affordable explosives including inert dense metal additives, trugstave, and nano-scale metal fuels that perovice density and reduced ignition sensitivity for air-delivered munitions. These technologies enabled the development of safer, less expensive explosive fills for inventory and future weapons. Completed warhead testing and evaluation of the reformulated MNX-221 explosive to verify improved density and reduced ignition sensitivity. Continued development of anew clas	2502	Ordnance Techno	logy	51,474	32,362	42,295	34,553	35,494	36,334	36,972	Continuing	
 (U) <u>FY 2001 (\$ in Thousands</u>) (U) \$6,736 Investigated and developed high fidelity analytical tools such as computational mechanics models for predicting weapons effects and assessing target vulnerability. These analysis tools reduced warhead development time and cost, thereby providing more effective munitions to the Air Force. Investigated demilitarization concepts for the 1000-pound unitary, general-purpose bomb. Developed a high-level model, including models of geological structures, involved in predicting penetrator performance against hard targets. Investigated innovative kill mechanisms for defeating weapons of mass destruction. Transitioned selected high fidelity analytical tools to weapon designers, DoD, and industry. Investigated and developed more efficient affordable explosives including inert dense metal additives, tungsten-laden explosives, cast and cure high energy composite explosives, and nano-scale metal fuels that provide both higher blast performance and lower ignition sensitivity for air-delivered munitions. These technologies enabled the development of safer, less expensive explosive fills for inventory and future weapons. Completed warhead testing and evaluation of the reformulated MNX-221 explosive to verify improved density and reduced ignition sensitivity. Continued development of innovative explosive technologies that allowed concentration of the explosive effects on the target, thereby reducing potential collateral damage. (U) \$5,343 Investigated and developed advanced fuze technologies, such as commercially available micro-mechanical systems, shock-hardened components, low energy detonators, light activated and modular firing systems for advanced single point initiation, switches, capacitors, power sources, and safe arming concepts for air-delivered munitions. The advanced fuze technologies enhanced lethality through precise selection of burst-height either at, above, or below the surface to increase weapon safety and tactical performance while	Note	 bite: In FY 2001, Project 2068 was combined with 2502. In FY 2002, Project 2068 was separated from 2502 for clarity of describing the different technologies. A. Mission Description This project investigates, develops, and evaluates conventional ordnance technologies to establish technical feasibility and military utility. Included in this project are technologies for advanced conventional weapon dispensers, submunitions, safe and arm devices, fuzes, explosives, warheads, and weapon airframe and carriage technology. The project also assesses the lethality and effectiveness of current and planned conventional weapons technology programs and assesses target vulnerability. The payoffs include: improved storage capability and transportation safety of fully assembled weapons; improved warhead and fuze effectiveness; 										
(U)\$3,316Investigated and developed more efficient affordable explosives including inert dense metal additives, tungsten-laden explosives, cast and cure high energy composite explosives, and nano-scale metal fuels that provide both higher blast performance and lower ignition sensitivity for air-delivered munitions. These technologies enabled the development of safer, less expensive explosive fills for inventory and future weapons. Completed warhead testing and evaluation of the reformulated MNX-221 explosive to verify improved density and reduced ignition sensitivity. Continued development of a new class of energetic materials based on nano-scale and micro-scale particles, with initial emphasis on improving handling safety. Initiated development of innovative explosive technologies that allowed concentration of the explosive effects on the target, thereby reducing potential collateral damage.(U)\$5,343Investigated and developed advanced fuze technologies, such as commercially available micro-mechanical systems, shock-hardened components, low energy detonators, light activated and modular firing systems for advanced single point initiation, switches, capacitors, power sources, and safe arming concepts for air-delivered munitions. The advanced fuze technologies enhanced lethality through precise selection of burst-height either at, above, or below the surface to increase weapon safety and tactical performance while simultaneously decreasingProject 2502Page 7 of 13 PagesExhibit R-2A (PE 0602602F)	(U) (U)	<u>FY 2001 (\$ in Thou</u> \$6,736	sands) Investigated and developed hi target vulnerability. These an Force. Investigated demilitar models of geological structure	igh fidelity a alysis tools ization conc es, involved	nalytical too reduced war epts for the in predicting	bls such as co head develo 1000-pound g penetrator	omputational pment time a unitary, gene performance	l mechanics and cost, the eral-purpose against har	models for p reby providi bomb. Dev d targets. In	predicting w ng more eff veloped a hig vestigated in	eapons effec ective muniti sh-level mod movative kil	ts and assessing ions to the Air el, including l mechanisms
(U) \$5,343Investigated and developed advanced fuze technologies, such as commercially available micro-mechanical systems, shock-hardened components, low energy detonators, light activated and modular firing systems for advanced single point initiation, switches, capacitors, power sources, and safe arming concepts for air-delivered munitions. The advanced fuze technologies enhanced lethality through precise selection of burst-height either at, above, or below the surface to increase weapon safety and tactical performance while simultaneously decreasingProject 2502Page 7 of 13 PagesExhibit R-2A (PE 0602602F)	(U)	for defeating weapons of mass destruction. Transitioned selected high fidelity analytical tools to weapon designers, DoD, and industry. 1) \$3,316 Investigated and developed more efficient affordable explosives including inert dense metal additives, tungsten-laden explosives, cast and cure high energy composite explosives, and nano-scale metal fuels that provide both higher blast performance and lower ignition sensitivity for air-delivered munitions. These technologies enabled the development of safer, less expensive explosive fills for inventory and future weapons. Completed warhead testing and evaluation of the reformulated MNX-221 explosive to verify improved density and reduced ignition sensitivity. Continued development of a new class of energetic materials based on nano-scale and micro-scale particles, with initial emphasis on improving handling safety. Initiated development of innovative explosive technologies that allowed concentration of the explosive effects on the target, thereby reducing potential collectoral demage										
Project 2502Page 7 of 13 PagesExhibit R-2A (PE 0602602F)	(U)	\$5,343	Investigated and developed ac components, low energy deto sources, and safe arming conc burst-height either at, above, o	dvanced fuze nators, light cepts for air- or below the	e technologie activated an delivered me surface to in	es, such as c d modular fi unitions. Th ncrease weap	ommercially ring systems e advanced pon safety ar	available m s for advance fuze technol nd tactical pe	icro-mechar ed single poi ogies enhand erformance v	nical systems int initiation ced lethality while simult	s, shock-hard , switches, ca through pred aneously dec	lened apacitors, power cise selection of reasing
	Р	roject 2502			Page	7 of 13 Pag	es			E>	hibit R-2A ((PE 0602602F)

	RDT&E	BUDGET ITEM JUSTIFICATION	SHEET (R-2A Exhibit)	DATE February 2002
BUD0 02 -	GET ACTIVITY - Applied Resear	ch	PE NUMBER AND TITLE 0602602F Conventional Munitions	PROJECT 2502
(U)	A. Mission Descripti	on Continued		
(U)	FY 2001 (\$ in Thousa	nds) Continued procurement costs and system supportability requirem components and fuze accelerometers. Developed and target fuze capable of 4000 feet per second impacts	ents. Investigated micro-electromechanical system teo initiated testing of a low-threshold energy, shock-hard	chnology concepts for safe and arm lened detector for multi-event, hard
(U)	\$5,317	Investigated and developed control and carriage techn weapon lethality. Examples of these technologies incluse technologies contributed to increasing weapon load-ou submunitions for survivability during high mach numb fast reaction weapon to engage and destroy time-critic utilized to improve munitions planning, performance	ologies for ordnance packages for advanced air-deliver luded high-energy explosives, mass focus fragmentation at on strike aircraft and increased sortie effectiveness. our dispensing. Began ground testing of technologies to al targets. Investigated the communication architectur and deployment	red munitions in order to enhance on, and multi-sensor fuzing. These Designed, fabricated, and tested that enabled the development of a res to determine if they could be
(U)	\$7,118	Investigated and developed advanced warhead kill me application of reactive metals and processing explosiv air-delivered munition lethality and enabled the develo- which resulted in a corresponding increase in strike ai of several candidate payload technologies to determin biological targets. Continued testing and characterizin of ground mobile threats. Completed in-house researc collateral damage effects to areas surrounding the targ mechanisms	chanisms, for instance adaptable warhead, directional e forming, and adjustable-yield ordnance packages. T opment of smaller munitions with effectiveness similar rcraft load-out and sortie effectiveness. Performed sub e their effectiveness to neutralize, deny, or destroy spe ng the effectiveness of tantalum warheads against target th on the effects of explosives on chemical and biologi et area. Completed research on explosive compressor	control and fragmenting ordnance, hese technologies enhanced to current inventory weapons, o-scale and full-scale experiments cially formulated chemical and ets that simulate the full spectrum cal containers to determine residual generators as novel, non-lethal kill
(U)	\$5,020	Investigated and developed advanced component tech signal pre-processing, target recognition, spatial target enhanced precision, adverse weather, and autonomous next generation seekers that increased a weapon's kill fabricated the subsystems for a gimbal-less, laser rada that identified mobile targets using their unique extern	nologies, including laser sources, detectors and detectors characteristics, optics, and beam scanning and shapin seekers for air-delivered munitions. These technolog probability, reduced pilot workload, and enhanced sort r sensor with total electronic scanning. Developed and cal components, such as guns or antenna.	or arrays, receiver electronics, g technology for lower cost, ies enabled the development of tie effectiveness. Designed and l validated advanced algorithms
(U)	\$5,071	Investigated and developed advanced navigation and o biomimetic guidance, clutter rejection modules, detect allowed an optimal flight path to the target and increase	control technologies for air-delivered munitions, for ex tion and segmentation modules, and micro-electromecl sed standoff ranges, enhanced strike aircraft effectiven	ample nonlinear controllers, hanical gyros. These technologies ess and survivability. Investigated
F	Project 2502	Page	8 of 13 Pages	Exhibit R-2A (PE 0602602F)
			204	

	RDT&I	E BUDGET ITEM JUSTIFICATION S	HEET (R-2A Exhibit)	DATE February 2002				
виро 02 -	GET ACTIVITY • Applied Reseat	PROJECT 2502						
(U)	A. Mission Descript	ion Continued						
(U)	J) <u>FY 2001 (\$ in Thousands) Continued</u> guidance and control technologies that could provide significantly enhanced capability to locate and engage a moving or partially hidden target. Developed a low-cost, multi-sensor navigation device using micro-electromechanical system technology that could meet tactical grade performance in a low-cost package. Fabricated components and began integration of the component intended for field testing for the multi-sensor navigation device. Combined components of advanced Global Positioning System and began laboratory bench tests for the multi-sensor navigation device.							
(U)	J) \$2,992 Investigated and developed advanced optical and digital processors and target detection, classification, and identification algorithms for improved seeker performance to allow greater air-delivered weapon autonomy. The advanced seekers would further deny an enemy's ability to hide or camouflage a target while decreasing the pilot's workload. Completed the phenomenology studies required validating the performance enhancements to be realized with a dual-mode, millimeter wave and infrared seeker. Developed the analytical tools required that enhanced the development, test, and analysis of advanced seekers and target detection and identification processors. Investigated optical processing and							
(U)	\$2,561	Investigated and developed detailed six-degree-of-free target recognition, and biomimetic processing. Simula models to analyze guided munitions or their componen reduction. These advanced simulations reduced develo generation capability to produce re-useable, governmen Completed the analysis of air-to-surface terminal fuzin weapon concepts.	dom and hardware-in-the-loop simulations, including tions also included trajectory optimization algorithm its to enable requirements studies, design iteration and opment cost and time, and provided more effective mint-owned acquisition and targeting software algorithm g. Developed in-house personal computer-based sim	synthetic aperture radar, automatic and polarization sensing and d evaluation, and experiment risk unitions. Developed tactical scene ns for guided munition seekers. ulations for analysis of advanced				
(U)	\$8,000	Developed microsatellite (10-100 kg) technologies, con evaluate autonomous space operations. (Note: In FY 2 was not the correct Program Element for this effort, so execution).	mbined sub-system technologies, and launched first n 2001, Congress added \$8.0 million for MicroSat Tech these funds were transferred to PE 0603401F, Advar	nicrosatellite in the XSS series to nology (XSS-10). However, this need Spacecraft Technology, for				
(U)	U) \$51,474 Total							
Р	roject 2502	Page	9 of 13 Pages	Exhibit R-2A (PE 0602602F)				
	205							

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002
BUD0 02 •	GET ACTIVITY - Applied Resear	PE NUMBER AND TITLE 0602602F Conventional Munitions	PROJECT 2502
(U)	A. Mission Descripti	on Continued	
(U) (U)	<u>FY 2002 (\$ in Thousa</u> \$6,206	nds) Investigate and develop high fidelity analytical tools such as computational mechanics models for predicting target vulnerability. These analysis tools will reduce air-delivered munitions development costs providing w maximum lethality against a given target class. Develop new hydro-code to improve predictive warhead per metal cutting, detonation waves, shear banding, and phase transitions. Develop a high fidelity model that pre and biological neutralizing agents from warheads. Upgrade and refine basic models describing fragmentation facilities, including weapons of mass destruction (WMD). Perform phenomenology tests to provide data for	weapons effects and assessing eapons that can generate formance capabilities by adding edicts the dispersion of chemical n effects against various target the development of lethality and
(U)	\$3,318	vulnerability codes for ground-fixed WMD targets. Investigate and develop more efficient, affordable explosives, including inert dense metal additives, tungsten high energy composite explosives, and nano-scale metal fuels that provide both higher blast performance and air-delivered munitions. These technologies enable safer, less expensive explosive fills for inventory and fut developing micro-scale and nano-scale fuel and oxidizer particles to create new, intermolecular energetic ma Department of Energy labs, complete efforts to develop a new class of materials for use in fragments, shaped projectiles. Develop insensitive explosive formulations for use in penetrator warheads capable of mach four development of a highly energetic material with twice the power density of conventional explosives, but exhi attributes. Evaluate intermolecular energetic material to measure mixing and fabrication techniques, materia augmentations for specific applications. Initiate dense reactive metal explosive research to investigate cost e	-laden explosives, cast and cure l lower ignition sensitivity for ure weapons. Continue terials. In collaboration with charges and explosively formed impact velocities. Initiate ibiting insensitive munition l properties, and performance ffective methods to improve
(U)	\$6,258	Investigate and develop advanced fuze technologies for air-delivered munitions, such as commercially availar shock-hardened fuzes, low energy detonators, light-activated and modular firing systems for advanced single capacitors, power sources and safe-arming concepts. The advanced fuze techniques will enhance lethality the burst-height at, above, or below the surface to increase weapon safety and tactical performance while simultar costs and system supportability requirements. Develop test methodology to analyze hardened-influence-fuze field-shock testing of fuze components. Initiate critical component design and fabrication of the next generated discrimination against foliage, rain, chaff, electronic countermeasures, and electromagnetic interference. Development battle damage assessment through hardened mediums.	ble micro-mechanical systems, point initiation, switches, rough precise selection of meously decreasing procurement components, and bench-level and tion burst-height fuze with velop technologies that
(U)	\$7,394	Investigate and develop control and carriage technologies for ordnance packages for advanced air-delivered response weapon lethality. Examples of these technologies include high-energy explosives, mass focus fragmentation	nunitions in order to enhance , and multi-sensor fuzing. These
F	Project 2502	Page 10 of 13 Pages	Exhibit R-2A (PE 0602602F)
		206	

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002
budg 02 -	ET ACTIVITY Applied Researe	PE NUMBER AND TITLE Ch 0602602F Conventional Munitions	PROJECT 2502
(U)	A. Mission Description	on Continued	
(U)	<u>FY 2002 (\$ in Thousa</u>	nds) Continued technologies will increase weapon system effectiveness by contributing to increased weapon load-out on strif effectiveness. Develop advanced munition dispenser electronics and software and investigate reduction of pl advanced carriage technology. Investigate alternate technologies, such as microbots, nano-encapsulation, to facilities involved with chemical and biological weapons. Continue investigating technologies for defeating	ke aircraft and enhanced sortie latform integration cost for the disrupt, deny, destroy, or damage hard and deeply buried targets.
(U)	\$9,186	Investigate and develop advanced warhead kill mechanisms, like adaptable warhead, directional control and application of reactive metals. The investigation includes characterization of the dynamic response of metals yield ordnance packages, and distributed multi-point fire set to enhance air-delivered munition lethality. This development of smaller munitions with effectiveness similar to current inventory weapons and with a corresp load-out and sortie effectiveness. Design, fabricate, and evaluate initiation-based, adaptable, and multi-mode lethality materials and miniaturization technologies for the advanced warhead kill mechanism. Fabricate and agent defeat warhead design to determine its ability to deny an adversary access to storage and production fa biological weapons. Analyze improvements to multi-mode warheads using heavy metal liners to enhance let experiments to characterize the interaction of munitions with chemical and biological containers.	fragmenting ordnance, and s and geologic materials, adjustable s enhanced lethality supports the ponding increase in strike aircraft e warheads using enhanced I test a chemical and biological cilities containing chemical or thality. Perform in-house
(U) (D)	\$32,362	Total	
(U) (U)	<u>FY 2003 (\$ in Thousa</u> \$6,507	Investigate and develop high fidelity analytical tools such as computational mechanics models for predicting target vulnerability. These analysis tools will reduce air-delivered munitions development costs providing w maximum lethality against a given target class. Develop new hydro-code to improve predictive warhead per metal cutting, detonation waves, shear banding, and phase transitions. Upgrade and refine basic models desc against various target facilities, including weapons of mass destruction (WMD). Perform phenomenology te development of lethality and vulnerability codes for ground-fixed WMD targets. Apply campaign analysis to budgeted and concentual munitions to identify high pay-off technologies	weapons effects and assessing reapons that can generate formance capabilities by adding cribing fragmentation effects sts to provide data for the ools to compare inventory,
(U)	\$5,206	Investigate and develop more efficient, affordable explosives including inert dense metal additives, tungsten- high energy composite explosives, and nano-scale metal fuels that provide both higher blast performance and air-delivered munitions. These technologies will enable safer, less expensive explosive fills for inventory an micro-scale and nano-scale fuel and oxidizer particles to create new, advanced, intermolecular energetic mate	-laden explosives, cast and cure d lower ignition sensitivity for d future weapons. Utilize erials. Complete efforts to develop
Pr	roject 2502	Page 11 of 13 Pages	Exhibit R-2A (PE 0602602F)

	RDT&B	BUDGET ITEM JUSTIFICATION SH	IEET (R-2A Exhibit)	DATE February 2002
BUD0 02 -	GET ACTIVITY - Applied Resear	ch P	E NUMBER AND TITLE 0602602F Conventional Munitions	PROJECT 2502
(U)	A. Mission Descripti	on Continued		
(U)	FY 2003 (\$ in Thousa	nds) Continued		
(U)	\$7,103	a new class of materials for use in fragments, shaped cha material with twice the power density of conventional ex of surviving Mach eight impacts that still functions as de and investigate cost-effective methods to improve curren Investigate and develop advanced fuze technologies for a shock-hardened fuzes, low energy detonators, light activa capacitors, power sources and safe-arming concepts. The burst-height at, above, or below the surface to increase w costs and system supportability requirements. Develop a	rges, and explosively formed projectiles. Continue plosives, but exhibiting insensitive munition attribu sired when initiated by the fuze. Continue research t explosives. ir-delivered munitions, such as commercially availa ated and modular firing systems for advanced single e advanced fuze technologies will enhance lethality eapon safety and tactical performance while simulta high resolution electromagnetic countermeasure-h	development of a highly energetic tes. Develop an explosive capable of dense reactive metal explosives able micro-mechanical systems, -point initiation, switches, through precise selection of aneously decreasing procurement ardened, active imaging fuze that
		calculates warhead burst direction and detonation time. I as micro-electromechanical system gyroscopes. Investig hardened mediums.	Determine the benefits of developing a high speed, l ate technologies that can communicate battle damag	ard target fuze using sensors such ard target fuze using sensors such
(U)	\$10,657	Investigate and develop control and carriage technologies weapon lethality. Examples of these technologies includ technologies will increase weapon systems effectiveness effectiveness. Investigate and compare the subsystem tec targets. Investigate technologies, such as microbots and and biological weapons. Investigate technologies that car time-of-arrival guided munitions on target.	s for ordnance packages for advanced air-delivered is e high-energy explosives, mass-focus fragmentation by contributing to increased weapon load-out on str chnologies necessary to develop an optimum kill mi nano-encapsulation, to disrupt, deny, destroy, or dar n defeat hard and deeply buried targets by simultane	nunitions in order to enhance n, and multi-sensor fuzing. These ike aircraft and enhanced sortie ssile against low-observable, air mage facilities containing chemical ously placing multiple, precise,
(U)	\$12,822	Investigate and develop advanced warhead kill mechanis application of reactive metals. The investigation includes yield ordnance packages, and distributed multi-point fire development of smaller munitions with effectiveness sim load-out and sortie effectiveness. Continue to evaluate in and miniaturization technologies for the advanced warher collateral damage with high near-field and minimum far- to enhance lethality. Complete in-house experiments to o	ms, like adaptable warhead, directional control and s characterization of the dynamic response of metals set to enhance air-delivered munition lethality. Thi ilar to current inventory weapons and with a corresp nitiation-based, adaptable, and multi-mode warheads ad kill mechanism. Begin evaluation of an ordnance field lethality. Complete assessment of multi-mode characterize the interaction of munitions with chemi	fragmenting ordnance, and s and geologic materials, adjustable s enhanced lethality supports the ponding increase in strike aircraft s using enhanced lethality materials e package designed for low warheads using heavy metal liners acal and biological weapon and
F	Project 2502	Page 12	of 13 Pages	Exhibit R-2A (PE 0602602F)
			208	

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R	DATE February 2002						
BUD(02 -	GET ACTIVITY PE NUMBER A - Applied Research 0602602F	ND TITLE Conventional Munitions	PROJECT 2502					
(U)	A. Mission Description Continued							
(U) (U)	FY 2003 (\$ in Thousands) Continued storage containers. Begin an effort to improve the attributes of penet control of depth of burial, trajectory control methodologies while pen greater amount of energetic material to be carried to required depth of \$42,295 Total	rating munitions by focusing on impro- etrating hardened material, and decrea f target.	ving warhead case survivability, sing case thickness to allow a					
(U)	B. Project Change Summary Not Applicable.							
(U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0603601F, Conventional Weapons Technology. This project has been coordinated through the Reliance process to harmonize efforts and elim	ninate duplication.						
(U)	D. Acquisition Strategy Not Applicable.							
(U) (U)	E. Schedule Profile Not Applicable.							
F	Project 2502 Page 13 of 13 Pages		Exhibit R-2A (PE 0602602F)					
	209							

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM 、	USTIFIC	CATION	SHEET	(R-2 E)	(hibit)		DATE	Februa	ary 2002
BUDGET ACTIVITY PE NUMBER AND TITLE 02 - Applied Research 0602605F DIRECTED ENERGY TECHNO					ECHNOL	OGY			
COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	31,110	34,616	39,936	40,251	40,748	42,266	43,078	Continuing	TBD
4866 Lasers & Imaging Technology	15,685	19,435	23,174	24,359	24,332	25,519	25,977	Continuing	твр
4867 Advanced Weapons & Survivability Technology	15,425	15,181	16,762	15,892	16,416	16,747	17,101	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0
Note: In FY 2003, space unique tasks in Project 4866 will space unique activities.	l be transferr	ed to PE 060)2500F in co	njunction w	ith the Space	: Commissio	n recommer	idation to co	nsolidate all
(U) <u>A. Mission Description</u> This PE covers research in directed energy technolo high power lasers (solid state and chemical) and as narrowband and wideband high power microwave of In FY 2002, Congress added \$1 million for Tactica	A. Mission Description This PE covers research in directed energy technologies, primarily lasers and high power microwaves that are not space unique. In lasers, this includes moderate to high power lasers (solid state and chemical) and associated optical components and techniques. In advanced weapons, this PE examines technologies such as narrowband and wideband high power microwave devices and antennas. Both areas also provide vulnerability/lethality assessments of representative systems. Note: In FY 2002, Congress added \$1 million for Tactical/Operations System Simulator.								

(U) <u>B. Budget Activity Justification</u>

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>C. Program Change Summary (\$ in Thousands)</u>

		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>
(U)	Previous President's Budget	32,041	36,678	37,827	
(U)	Appropriated Value	32,337	34,678		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions		-62		
		Page 1 of 11 Pages		Exhibit R	-2 (PE 0602605F)

	RDT&E BUDGET ITEM JUSTIFICAT	ION SHEET (R-2 Exhib	oit)	DATE February 2002				
BUDO 02 -	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602605F DIRECTE	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECH					
(U)	C. Program Change Summary (\$ in Thousands) Continued	<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>			
	 c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram 	-157						
(U)	e. Rescissions Adjustments to Budget Years Since FY 2002 PBR	-296	24 (1)	2,109	רוחד			
(U) (U)	Significant Program Changes:	31,110	34,010	39,936	IBD			
	Not Applicable.							
		Page 2 of 11 Pages		Exhibit R-2	(PE 0602605F)			

	RDT&I	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDO 02 -	GET ACTIVITY • Applied Resea l	rch			PE NUMBE	R AND TITLE		IERGY T	ECHNOL	.OGY	PROJECT 4866
	COST (\$ in Thousands)FY 2001 ActualFY 2002 Estimate866Lasers & Imaging Technology15,68519,435				FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4866	Lasers & Imaging	Technology	15,685	19,435	23,174	24,359	24,332	25,519	25,977	Continuing	TBD
Note space	: In FY 2003, space u e unique activities.	nique tasks in Project 4866 will	be transferr	ed to PE 060)2500F in co	njunction w	ith the Space	e Commissio	on recommend	ndation to co	nsolidate all
(U)	A. Mission Description This project examines the technical feasibility of moderate to high power lasers and associated optical components required for Air Force missions including long- and short-range weapons, weapon support such as aimpoint selection, and force protection that are not space unique. Technologies applicable for a wide range of vehicles including unmanned combat air vehicles and fighters are being developed. High power solid state and chemical laser devices, optical components, advanced beam control and atmospheric compensation technologies, laser target vulnerability assessment techniques, and advanced optical processes and techniques are developed. Advanced short-wavelength laser devices for applications such as illuminators and imaging sources for target identification and assessment are developed.										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$2,091	ands) Developed long-range optical membrane mirror issues for s required curvature and demon	technologie caling to ver	es for increas y large size	sed resolutio (~ 10-meter	n, characteri mirrors). A pility on scal	zation, and o ddressed iss ed optics in	lata fusion a ues associate laboratory e	pplications. ed with prod	Explored li ucing a mirre	ghtweight or close to
(U)	\$724	Developed and field tested no aperture lightweight optics. T technology were scaled up in extend the wavelength regime	ovel, advance The novel, ac size and inte e and reduce	ed optics tec lvanced opti egrated into the number	hnologies to cs compone laboratory/fi of such com	support bea nts that prov eld tests and ponents wer	m projection ide optical c demonstrat re pursued.	and imagin ompensation ions. Additi	g applicatio 1 for beam p onal improv	ns associated rojection and ements and t	l with large l imaging rechniques to
(U)	 \$4,769 beveloped high power chemical laser technologies for applications such as directed energy weapons, illuminators, and wavelength specific applications. Performed engineering validation of advanced chemical oxygen iodine laser nozzle concepts which include iodine atom production techniques and integrated ejector nozzle concepts. Continued to develop/refine a subsonic all gas phase iodine laser demonstrator. 										
(U)	\$2,684	Developed laser source, beam missile threats to aircraft. De power and pulse duration, thi materials effects associated w	control, and eveloped an e s will lead to with ultra-fast	d target coup electrically p eliminating t lasers for c	bling technol bumped mid- g the optical ountering fo	ogies to cou infrared soli pump source cal plane arr	nter current d state laser e and cryoge ay seekers.	and next gen operating at nic cooler fo Obtained a l	neration air- room tempo or mid-infrar nigh fidelity	to-air and superature. With ed lasers. In surrogate se	rface-to-air n increased vestigated novel eker for
Р	roject 4866			Page	3 of 11 Pag	es			Ex	hibit R-2A	(PE 0602605F)

	RDT&E	BUDGET ITEM JUSTIFICATION SH	IEET (R-2A Exhibit)	DATE Februa	ry 2002
BUDO 02 -	GET ACTIVITY	ch F	E NUMBER AND TITLE 0602605F DIRECTED ENERGY TECH	NOLOGY	PROJECT 4866
(U)	A. Mission Description	on Continued			
(U)	FY 2001 (\$ in Thousa	<u>ads) Continued</u> laboratory effects testing. Developed a moderate power characteristics.	ultra-fast laser source for investigations of novel atm	nospheric propagati	on
(U)	\$5,417	Developed low-cost, scalable, high power solid state lase energy applications such as unmanned aerial vehicle desi and airborne lasers. Developed promising fiber laser tect scalability that will enable applications that require laser 100 watts.	r architectures by integrating fiber lasers with diode gnators/imagers and next generation weapons appli nnologies exhibiting attributes such as low-cost, hig mobility. Developed integration technologies for de	laser pump source cations such as space h efficiency, compa emonstration of pov	s for directed ce-based lasers actness and wer greater than
(U)	\$15,685	Total			
(U)	FY 2002 (\$ in Thousa	<u>nds)</u>			
(U)	\$1,504	Develop and field test advanced long-range optical techn advanced optical devices for faster corrections, increased environment. Emphasize extending the wavelength cover components and extending the wavelength coverage have membrane mirror with near final curvature and demonstr	ologies to support beam projection and imaging app resolution, and larger apertures. Test and character rage and decreasing number of system components. e major applications to space-based optical systems. ate holographic correction of the mirror surface.	blications. Develop rize these devices in Decreasing the nu Produce one-mete	novel, 1 a laboratory 1mber of system 2r class
(U)	\$5,073	Develop high power chemical laser technologies for appl applications. Optimize high pressure ejector nozzle perfe applications such as airborne lasers. Investigate low basis airborne applications. Begin construction of a combusto the radio frequency-pumped overtone carbon monoxide l sensing applications.	ications such as directed energy weapons, illuminat ormance and iodine atom generation for potential lo c hydrogen peroxide flow rate and zero-gravity sing r-driven one kilowatt supersonic all gas-phase iodin aser in various spectral bands of interest for infrared	ors, and wavelength ng-range technolog glet delta oxygen ge e laser. Improve the l countermeasures a	n specific y insertion into nerators for e efficiency of and remote
(U)	\$3,561	Develop and demonstrate high-energy laser technologies Technologies being addressed include lasers for long-ran atmospheric jitter, and aero-optic effects. Develop and d tracking, and defeating electro-optical targets.	for airborne tactical applications, including air-to-a ge detection of targets in clutter, advanced beam co emonstrate multifunctional laser components capab	ir and surface-to-ain ntrol to control plat le of detecting, iden	r scenarios. form vibration, ntifying,
(U)	\$5,540	Develop low-cost, scalable, high power solid state laser a designators/imagers and next generation weapons application	architectures for directed energy applications such as ations such as space-based lasers and airborne lasers	s unmanned aerial v . Begin developing	ehicle g promising
Р	roject 4866	Page 4 of	of 11 Pages	Exhibit R-2A (I	PE 0602605F)

	RDT&E	February 2002				
BUDG 02 -	GET ACTIVITY • Applied Resear	PE NUMBER AND TITLE Ch 0602605F DIRECTED ENERGY TECH	NOLOGY	PROJECT 4866		
(U)	A. Mission Description	on Continued				
(U)	FY 2002 (\$ in Thousa	nds) Continued fiber laser technologies exhibiting attributes such as low-cost, high efficiency (approaching 30%), compaction integration technologies necessary for combining multiple fiber laser modules including coherent, spectral as combining technologies.	ess, and scalability. Dend nonlinear optical bea	evelop am		
(U)	\$528	Develop advanced laser remote optical sensing technology to support standoff detection of chemical/biologic intelligence on weapons of mass destruction, bomb damage assessment, target characterization, and theater i reconnaissance. Complete Phase II experiments for frequency agile heterodyne receiver development.	cal aerosols for signatu ntelligence, surveillanc	re xe, and		
(U)	\$2,238	Assess the vulnerability of six satellites (U.S., NATO, and foreign) to the effects of directed energy weapons Update previously completed assessments on catalogued satellites. Fuse finite state models with other satell a more complete space situational awareness posture.	s, primarily high energy ite data and observable	7 lasers. s to produce		
(U)	 \$991 Develop the Tactical Operations System Simulator to model, evaluate, trade, and optimize directed energy concepts and tactical employment. Develop software/hardware simulation tools to assess performance, demonstrate military utility and benefits to the warfighter, and to identify requirements and technology shortfalls. Integrate tools to provide a government systems engineering, simulation, and operational research canability 					
(U)	\$19,435	Total				
(U)	FY 2003 (\$ in Thousa	<u>nds)</u>				
(U)	\$2,822	This project previously included space unique tasks which have been transferred to PE 0602500F, Multi-disc funds represent the civilian salaries for the transferred work efforts and they will be transferred at a later date	ciplinary Space Techno	logy. These		
(U) (U)	\$4,995 \$4,981	Develop high power chemical laser technologies for applications such as directed energy weapons, illuminat applications. Perform scaled demonstration of optimized high pressure ejector nozzles incorporating iodine potential long-range technology insertion into airborne laser applications. Investigate low flow rate basic hy generator concepts and complete the design of the most promising concept for fabrication and bench testing. development, investigate means to cut the chemical laser logistic trail through chemical regeneration or sing generators. Demonstrate an enhanced overtone carbon monoxide laser in configuration suitable for transitio countermeasure applications. Improve the efficiency of the radio frequency-pumped overtone carbon monox of interest for infrared countermeasure and remote sensing applications. Develop and demonstrate high-energy laser technologies for airborne tactical applications, including air-to-a	ors, and wavelength sp atom generation as app drogen peroxide and ze In concert with genera- le pass singlet delta ox n to potential airborne kide laser in various spe ir and surface-to-air sc	ecific propriate for ero-gravity ator ygen infrared ectral bands enarios.		
P	roject 4866	Page 5 of 11 Pages	Exhibit R-2A (PE	0602605F)		

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002						
BUDO			PROJECT						
(U)	A. Mission Descripti	on Continued							
an an	FY 2003 (\$ in Thousa	nds) Continued							
(U)	 Technologies being addressed include lasers for long-range detection of targets in clutter, high-power compact lasers, advanced beam control to control platform vibration, atmospheric jitter, and aero-optical effects. Continue developing laser sources and supporting technology for detecting, identifying, tracking, and defeating electro-optical targets. Demonstrate 30-watt, near-diffraction-limited, 1.5 micron laser. \$7,136 Develop low-cost, scalable, high power solid-state laser architectures by integrating fiber lasers with diode-laser pump sources for directed energy applications such as unmanned aerial vehicle designators/imagers and next generation weapons applications such as space-based and airborne lasers. Develop promising fiber laser technologies for a demonstration of attributes such as low-cost, high efficiency, compactness, and scalability. Develop integration technologies necessary for combining multiple fiber laser modules exhibiting powers near one kilowatt. 								
(U)	\$1,760	Develop advanced laser remote optical sensing technology to support standoff detection of chemical/biolo intelligence on weapons of mass destruction, bomb damage assessment, target characterization, and theate reconnaissance. Initial design and development of flight-qualifiable hardware for differential absorption la	cical aerosols for signature intelligence, surveillance, and ser radar applications.						
(U)	\$1,480	Perform vulnerability assessments on potential high energy laser targets to provide critical design data for Update lethality assessment methodology by anchoring modeling tools to empirical data. Conduct vulnera used for lethality assessments, system effectiveness, and system concept definition. Perform lethality assesses laser concepts to provide critical data for designing laser systems.	aser systems to defeat these targets. bility experiments to update data ssments on potential high-energy						
(U)	\$23,174	Total							
(U)	<u>B. Project Change S</u> Not Applicable.	ummary							
(U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Fr Related Activities: PE 0602500F, Multi-I PE 0603444F, Maui S PE 0603500F, Multi-I PE 0603605F, Advance PE 0603883C, Ballisti This project has been of	unding Summary (\$ in Thousands) Disciplinary Space Technology. pace Surveillance System. Disciplinary Advanced Development Space Technology. ced Weapons Technology. c Missile Defense Boost Phase Segment. coordinated through the Reliance process to harmonize efforts and eliminate duplication.							
Р	roject 4866	Page 6 of 11 Pages	Exhibit R-2A (PE 0602605F)						

	RDT&E BUDGET ITEM J	USTIFICATION SHEET (R-2A Exhibit)	DATE February 2002
BUDO			PROJECT
02 -	Applied Research	0602605F DIRECTED ENERGY TECH	HNOLOGY 4866
(U)	D. Acquisition Strategy Not Applicable.		
(U)	E. Schedule Profile		
(U)	Not Applicable.		
Р	roject 4866	Page 7 of 11 Pages	Exhibit R-2A (PE 0602605F)
		217 UNCLASSIFIED	

\square	RDT&	E BUDGET ITEM JU	JSTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	rv 2002
вирс 02 -	BET ACTIVITY • Applied Resea	rch			PE NUMBE	R AND TITLE	, CTED EN	IERGY T	ECHNOL	.OGY	PROJECT 4867
	COST (\$ in Thousands)FY 2001 ActualFY 2002 Estimate4867Advanced Weapons & Survivability Technology15,42515,181				FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4867	Advanced Weapor	s & Survivability Technology	15,425	15,181	16,762	15,892	16,416	16,747	17,101	Continuing	TBD
(U)	U) <u>A. Mission Description</u> High power microwave (HPM) and other unconventional weapon concepts using innovative technologies are explored in this project. Technologies that support a wide range of Air Force missions such as the potential disruption and degradation of an adversary's electronic infrastructure and military capability are developed. This effect can often be applied covertly with no collateral structural or human damage. These targeted capabilities include local computer and communication systems as well as large and small air defense and command and control systems. This project also provides for vulnerability assessments of representative U.S. strategic and tactical systems to HPM weapons, HPM weapon technology assessment for specific Air Force missions, and HPM weapon lethality assessments against foreign targets.						nat support a e developed. unication tative U.S. ssments against				
(U)	FY 2001 (\$ in Thous	ands)									
(U)	\$2,846	Investigated and developed te applications. Continued inve gaming activities. Investigate repetitively operated sources. support compact single-shot l	echnologies s stigation of l ed high effic Started pul HPM source	for multi-put better source iency repetit sed atmosph s.	lsed narrowb e modeling te tively-pulsed heric breakdo	and and wid chniques in HPM sourc wn experime	eband HPM order to inco e. Develope ents. Started	component orporate HP ed frequency d explosive g	s to support M technolog agile HPM generator de	multiple Air gies into warf source. Dev velopment es	Force ighting/war eloped compact speriments to
(U)	\$1,801	Assessed effects/lethality of I susceptibility tests of represent repetition rates.	HPM weapon tative comr	n technologi nand and co	es against rej ntrol warfare	presentative targets. Inv	air and grou vestigated ef	nd military fects on targ	systems. Co ets of HPM	ontinued to co sources puls	onduct ed at high
(U) (U)	 repetition rates. \$1,932 Investigated and developed wideband HPM technologies that support command and control warfare and other wideband applications. Researched advanced antenna designs driven by mission concepts. Continued applied research to improve wideband HPM sources in order to achieve greater range or smaller packaging. Continued advancement of computer codes' ability to predict the electromagnetic coupling to target equipment and probability of effect inside increasingly complex structures. Expanded HPM effects prediction models for implementation into engagement scenario models. Researched methods to enhance HPM source technology such as power throughput for solid state switches and high repetition rates for high pressure gas switches. J) \$2,673 Developed narrowband HPM technologies that support suppression of enemy air defenses through the use of reusable airborne platforms and municipate Continued to support suppression of enemy air defenses through the use of reusable airborne platforms and municipate contract of interpret. 							ations. rces in order to coupling to r bughput for solid platforms and terest.			
Р	roject 4867			Page	8 of 11 Pag	es			E>	hibit R-2A	PE 0602605F)
BUIDDET ACTIVITY PERQUECT PERDUET PERQUECT PERDET PERDET PERDET PERDET PERDET PERDET PERQUECT PERQUECT PERQUECT PERQUECT PERQUECT PERQUECT PERQUECT		RDT&E	DATE February 2002								
---	---------------------	-------------------------------	--	--							
(I) A.Mission Description Continued (I) FY 2001 (\$ in Thoussands) Continued (I) State of the product of principle capability for single is hot technologies. Completed design of subscale (laboratory) breadboard HPM system to validate approach and capability for repetitively pulsed technologies of high power microwave (HPM) munitions and airborne electronic attack. Continued development of component technologies – pulsed power, sources, and antennas – for repetitively pulsed airborne and munitions systems. (I) \$3,491 Investigated HPM technologies that support offensive and defensive advanced airborne tactical applications, to include airborne and munitions platforms, made possible by the increased power available on future aircraft. Investigated enhanced sources for the most promising concepts identified by the FY 2000 tradeoff study. Continued to develop HPM effects database of commercial-off-the-shelf sources, missile targets, and aircraft platforms. (I) \$1,883 Assessed the vulnerability of seven satellites (U.S. NATO, and foreign) to the effects of directed energy weapons, primarily high energy basers. Updated previously completed assessments on catalogued satellites. Began developing finite state models to predict satellite performance from observed behavior to support space situational awareness. Compiled assessment data and models into easily accessible folders for satellite endocupand technologies to support agile combat support apuplications. Continued development of active d	BUDO 02 -	GET ACTIVITY - Applied Resear	Ch PE NUMBER AND TITLE Ch 0602605F DIRECTED ENERGY TECH	PROJECT NOLOGY 4867							
 (1) FY 2001 (5 in Thousands) Continued Continued validation of predictability of models. Continued investigation of pulsed power and HPM source capability to support an integrated experiment to show proof-of-principle capability for single shot technologies. Completed design of subscale (laboratory) breadboard HPM system to validate approach and capability for repetitively pulsed technologies for high power microwave (HPM) munitions and airborne electronic attack. Continued development of component technologies – pulsed power, sources, and antennas – for repetitively pulsed airborne and munitions systems. (U) \$3.491 Investigated HPM technologies that support offensive and defensive advanced airborne tactical applications, to include airborne and munitions platforms, made possible by the increased power available on future aircraft. Investigated enhanced sources for the most promising concepts identified by the FY 2000 tradeoff study. Continued to develop HPM effects database of commercial-off-the-shelf sources, missile targets, and aircraft platforms. (U) \$1.883 Assessed the vulnerability of seven satellites (U.S., NATO, and foreign to the effects of directed energy weapons, primarily high energy lasers. Updated previously completed assessments on catalogued statellites. Bad developing finite state models to predict satellite performance from observed behavior to support space situational awareness. Compiled assessments data and models into easily accessible folders for satellite characterization. (U) \$799 Investigated the best means for active denial technologies to support agile combat support multiple Air Force applications such as the disruption of electronic systems and subsystems. Continue to improve the electrical efficiency of wideband HPM sources in order to achieve greater range, longer lifetime, or smaller packaging. Integrate pulsed power, sources, and antennas – for repetitively pulsed airborne and munitions systems. Select a repetiti	(U)	A. Mission Descripti	on Continued								
(U) \$3,491 Investigated HPM technologies that support offensive and defensive advanced airborne tactical applications, to include airborne and munitions platforms, made possible by the increased power available on future aircraft. Investigated enhanced sources for the most promising concepts identified by the FY 2000 tradeoff study. Continued to develop HPM effects database of commercial-off-the-shelf sources, missile targets, and aircraft platforms. (U) \$1,883 Assessed the vulnerability of seven satellites (U.S., NATO, and foreign) to the effects of directed energy weapons, primarily high energy lasers. Updated previously completed assessments on catalogued satellites. Began developing finite state models to predict satellite performance from observed behavior to support space situational awareness. Compiled assessment data and models into easily accessible folders for satellite characterization. (U) \$799 Investigated the best means for active denial technologies to support agile combat support applications. Continued development of millimeter wave sources of active denial technologies to support agile combat support applications. Continued development of millimeter wave source enhancement technologies to support agile combat support applications. Continue development of millimeter wave source enhancement technologies for narrowband and wideband HPM components to support multiple Air Force applications such as the distruption of electronic systems and subsystems. Continue to improve the electrical efficiency of wideband HPM sources in order to achieve greater range, longer lifetime, or smaller packaging. Integrate pulsed power and HPM source to show capability for single shot technologies. Select a repetitively pulsed HPM source. Conduct laboratory test of frequency agile HPM source. Continue development of component technol	(U)	FY 2001 (\$ in Thousa	Continued Validation of predictability of models. Continued investigation of pulsed power and HPM source experiment to show proof-of-principle capability for single shot technologies. Completed design of subscale system to validate approach and capability for repetitively pulsed technologies for high power microwave (H electronic attack. Continued development of component technologies – pulsed power, sources, and antennas and munitions systems.	capability to support an integrated e (laboratory) breadboard HPM IPM) munitions and airborne s – for repetitively pulsed airborne							
 (U) \$1,883 Assessed the vulnerability of seven satellites (U.S., NATO, and foreign) to the effects of directed energy weapons, primarily high energy lasers. Updated previously completed assessments on catalogued satellites. Began developing finite state models to predict satellite performance from observed behavior to support space situational awareness. Compiled assessment data and models into easily accessible folders for satellite characterization. (U) \$799 Investigated the best means for active denial technologies to support agile combat support applications. Continue development of millimeter wave sources for active denial technologies to support sincluding beam transport and power extraction. Investigated millimeter wave source enhancement technologies group the simulations. (U) \$15,425 Total (U) <u>FY 2002 (\$ in Thousands</u>) (U) \$6,600 Investigate and develop technologies for narrowband and wideband HPM components to support multiple Air Force applications such as the disruption of electronic systems and subsystems. Continue to improve the electrical efficiency of wideband HPM sources in order to achieve greater range, longer lifetime, or smaller packaging. Integrate pulsed power and HPM source to show capability for single shot technologies. Select a repetitively pulsed multi-gigawatt technology for HPM breadboard munitions and airborne electronic attack proof-of-concept. Continue development of component technologies – pulsed power, sources, and antennas – for repetitively pulsed airborne and munitions systems. Design high efficiency repetitively pulsed HPM source. Conduct laboratory test of frequency agile HPM source. Continue development of compact repetitively pulsed HPM sources. Project 4867 Page 9 of 11 Pages Exhibit R-2A (PE 0602605F) 	(U)	\$3,491	Investigated HPM technologies that support offensive and defensive advanced airborne tactical applications, platforms, made possible by the increased power available on future aircraft. Investigated enhanced sources identified by the FY 2000 tradeoff study. Continued to develop HPM effects database of commercial-off-the aircraft platforms.	to include airborne and munitions for the most promising concepts e-shelf sources, missile targets, and							
 (U) \$799 Investigated the best means for active denial technologies to support agile combat support applications. Continued development of millimeter wave sources for active denial technology and conducted experiments including beam transport and power extraction. Investigated millimeter wave source enhancement technologies using computer simulations. (U) \$15,425 Total (U) <u>FY 2002 (\$ in Thousands</u>) (U) \$6,600 Investigate and develop technologies for narrowband and wideband HPM components to support multiple Air Force applications such as the disruption of electronic systems and subsystems. Continue to improve the electrical efficiency of wideband HPM sources in order to achieve greater range, longer lifetime, or smaller packaging. Integrate pulsed power and HPM source to show capability for single shot technologies. Select a repetitively pulsed multi-gigawatt technologies – pulsed power, sources, and antennas – for repetitively pulsed airborne and munitions systems. Design high efficiency repetitively pulsed HPM source. Conduct laboratory test of frequency agile HPM source. Continue development of component to support compact single-shot HPM sources. Project 4867 Page 9 of 11 Pages Exhibit R-2A (PE 0602605F) 	(U)	\$1,883	Assessed the vulnerability of seven satellites (U.S., NATO, and foreign) to the effects of directed energy we Updated previously completed assessments on catalogued satellites. Began developing finite state models to observed behavior to support space situational awareness. Compiled assessment data and models into easily characterization.	apons, primarily high energy lasers. predict satellite performance from accessible folders for satellite							
(U) \$15,425 Total (U) <u>FY 2002 (\$ in Thousands)</u> (U) \$6,600 Investigate and develop technologies for narrowband and wideband HPM components to support multiple Air Force applications such as the disruption of electronic systems and subsystems. Continue to improve the electrical efficiency of wideband HPM sources in order to achieve greater range, longer lifetime, or smaller packaging. Integrate pulsed power and HPM source to show capability for single shot technologies. Select a repetitively pulsed multi-gigawatt technology for HPM breadboard munitions and airborne electronic attack proof-of-concept. Continue development of component technologies – pulsed power, sources, and antennas – for repetitively pulsed airborne and munitions systems. Design high efficiency repetitively pulsed HPM source. Conduct laboratory test of frequency agile HPM source. Continue development of compact repetitively pulsed atmospheric breakdown experiments. Continue explosive generator development experiments to support compact single-shot HPM sources. Project 4867 Page 9 of 11 Pages Exhibit R-2A (PE 0602605F)	(U)	\$799	Investigated the best means for active denial technologies to support agile combat support applications. Con wave sources for active denial technology and conducted experiments including beam transport and power e wave source enhancement technologies using computer simulations.	tinued development of millimeter xtraction. Investigated millimeter							
(U) <u>FY 2002 (\$ in Thousands</u>) (U) \$6,600 Investigate and develop technologies for narrowband and wideband HPM components to support multiple Air Force applications such as the disruption of electronic systems and subsystems. Continue to improve the electrical efficiency of wideband HPM sources in order to achieve greater range, longer lifetime, or smaller packaging. Integrate pulsed power and HPM source to show capability for single shot technologies. Select a repetitively pulsed multi-gigawatt technology for HPM breadboard munitions and airborne electronic attack proof-of-concept. Continue development of component technologies – pulsed power, sources, and antennas – for repetitively pulsed airborne and munitions systems. Design high efficiency repetitively pulsed HPM source. Conduct laboratory test of frequency agile HPM source. Continue development of compact repetitively operated sources. Continue pulsed atmospheric breakdown experiments. Continue explosive generator development experiments to support compact single-shot HPM sources. Project 4867 Page 9 of 11 Pages Exhibit R-2A (PE 0602605F)	(U)	\$15,425	Total								
(U)\$6,600Investigate and develop technologies for narrowband and wideband HPM components to support multiple Air Force applications such as the disruption of electronic systems and subsystems. Continue to improve the electrical efficiency of wideband HPM sources in order to achieve greater range, longer lifetime, or smaller packaging. Integrate pulsed power and HPM source to show capability for single shot technologies. Select a repetitively pulsed multi-gigawatt technology for HPM breadboard munitions and airborne electronic attack proof-of-concept. Continue development of component technologies – pulsed power, sources, and antennas – for repetitively pulsed airborne and munitions systems. Design high efficiency repetitively pulsed HPM source. Conduct laboratory test of frequency agile HPM source. Continue development of compact repetitively operated sources. Continue pulsed atmospheric breakdown experiments. Continue explosive generator development experiments to support compact single-shot HPM sources.Exhibit R-2A (PE 0602605F)Project 4867Page 9 of 11 PagesExhibit R-2A (PE 0602605F)	(U)	FY 2002 (\$ in Thousa	unds)								
Project 4867 Page 9 of 11 Pages Exhibit R-2A (PE 0602605F)	(U)	\$6,600	Investigate and develop technologies for narrowband and wideband HPM components to support multiple A disruption of electronic systems and subsystems. Continue to improve the electrical efficiency of wideband greater range, longer lifetime, or smaller packaging. Integrate pulsed power and HPM source to show capab Select a repetitively pulsed multi-gigawatt technology for HPM breadboard munitions and airborne electronic Continue development of component technologies – pulsed power, sources, and antennas – for repetitively p systems. Design high efficiency repetitively pulsed HPM source. Conduct laboratory test of frequency agil development of compact repetitively operated sources. Continue pulsed atmospheric breakdown experiment development sto support compact single-shot HPM sources.	ir Force applications such as the HPM sources in order to achieve ility for single shot technologies. In attack proof-of-concept. ulsed airborne and munitions e HPM source. Continue ts. Continue explosive generator							
	Р	Project 4867	Page 9 of 11 Pages	Exhibit R-2A (PE 0602605F)							

	RDT&E	DATE February 2002			
BUD(02 -	GET ACTIVITY - Applied Researd	h	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECH	PROJECT	Г
(U)	A. Mission Description	n Continued			
(U) (U)	<u>FY 2002 (\$ in Thousa</u> \$2,869	ds) Continued Assess effects/lethality of HPM weapon technologies susceptibility tests of representative command and con- targets. Implement effects data and results into narrow computer codes' ability to predict the wideband electr predictability of high power microwave (HPM) narrow Continue validation of predictability of models. Con- technologies into warfighting/war gaming activities.	against representative air and ground military systems. ntrol warfare targets. Conduct susceptibility tests of hi wband and wideband HPM experiments and demonstra omagnetic coupling to increasingly complex structures wband effects models to damage or disrupt military ele tinue developing better HPM source modeling techniqu	Continue to conduct gh, repetitively pulsed effects on ations. Continue validation of continue to expand range of ctronic targets of interest. ues to incorporate HPM	
(U) (U)	\$3,917 \$1,795	Investigate HPM technologies that support offensive a platforms, made possible by the increased power avai identified by the tradeoff study to include an HPM rep experiments upon targets of interest to determine effe- characterize commercial-off-the-shelf sources and air Investigate the best means for active denial technology,	and defensive advanced airborne tactical applications, t lable on future aircraft. Develop enhanced sources for petitively pulsed source on an unmanned aerial platform ctual lethality of each concept. Continue development craft platforms. ies to support agile combat support applications. Cond including airborne active denial. Conduct experiments	to include airborne and munitions the most promising concepts n. Continue to perform effects of HPM effects database and luct preliminary design study of s including power combining,	
(U)	\$15,181	Total	gate source ennancement technologies using computer	simulations.	
(U) (U)	<u>FY 2003 (\$ in Thousa</u> \$7,638	ds) Investigate and develop technologies for narrowband disruption of electronic systems and subsystems. Cor compact repetitively operated sources. Continue puls experiments to support compact single-shot HPM sou	and wideband HPM components to support multiple A tinue laboratory testing of frequency agile HPM source sed atmospheric breakdown experiments. Continue exp rces. Conduct a subscale (laboratory) repetitively pulse	ir Force applications such as the e. Continue development of plosive generator development ed gigawatt class experiment.	
(U)	\$2,600	Assess effects/lethality of HPM directed energy weap conduct susceptibility tests of representative comman- pulsed effects on targets. Continue to implement effe Support refinement of codes to predict probability of better source modeling techniques to incorporate HPM	on technologies against representative air and ground r d and control warfare targets. Continue to conduct sus- cts data and results into narrowband and wideband HPI effect on target equipment and to guide experiment dire I technologies into warfighting/wargaming activities.	nilitary systems. Continue to ceptibility tests of high repetitively M experiments and demonstration ection. Continue development of Continue validation of computer	y s.
F	Project 4867	Page	10 of 11 Pages	Exhibit R-2A (PE 0602605F	-)
			220		

	RDT&E	DATE February 2002				
BUDO 02 -	GET ACTIVITY • Applied Resear	ch	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECH	PROJECT NOLOGY 4867		
(U)	A. Mission Descripti	on Continued				
(U)	FY 2003 (\$ in Thousa	nds) Continued codes' ability to accurately predict the electromagnetic	coupling to, and probability of effect on, target equip	ment within complex structures.		
(U)	\$760	Develop and apply theory of advanced computation to dispersions and enhance plasma models and physics all component technologies.	enhance the development of HPM and related technol gorithm development for HPM technologies. Perform	ogy. Investigate numerical virtual prototyping for HPM		
(U)	 \$4,888 Continue to investigate high power microwave (HPM) technologies that support offensive and defensive advanced airborne tactical applications, to include airborne and munitions platforms, made possible by the increased power available on future aircraft. Down select improved sources for the most promising concepts identified by the trade-off study to include an HPM repetitively pulsed source on an air platform. Continue to perform effects experiments upon targets of interest to determine effectual lethality of each concept. Continue davalormment of HPM offects database and continue to characterize commercial off the shelf sources and size of platforms. 					
(U)	\$876	Continue investigation of best means for active denial millimeter wave sources for active denial technology a Investigate source enhancement technologies using con	technologies to support Agile Combat Support applica nd associated support subsystems. Begin virtual proto nputer simulations.	tions. Complete design study of otyping of millimeter wave source.		
(U) (U)	B. Project Change S Not Applicable.	immary				
(U) (U) (U) (U) (U)	C. Other Program Fr Related Activities: PE 0602202F, Human PE 0603605F, Advance This project has been of	Inding Summary (\$ in Thousands) Systems Technology. ed Weapons Technology. coordinated through the Reliance process to harmonize of	efforts and eliminate duplication.			
(U)	D. Acquisition Strate Not Applicable.	<u>ev</u>				
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.					
Р	roject 4867	Page 1	1 of 11 Pages	Exhibit R-2A (PE 0602605F)		

THIS PAGE INTENTIONALLY LEFT BLANK

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)						DATE	February 2002		
budge ⁻ 02 - A	r activity pplied Research		PE NUMBE	r and title 2F Comi	mand Co	ntrol and	l Commu	inication	S	
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	84,376	66,561	70,951	80,767	82,897	84,463	86,587	Continuing	TBD
4519	Communications Technology	21,784	15,855	16,331	15,251	16,581	17,020	17,476	Continuing	TBD
4594	Information Technology	31,601	23,143	24,210	24,492	24,722	25,389	26,071	Continuing	TBD
4600	Electromagnetic Technology	10,247	0	0	0	0	0	0	Continuing	TBD
4917	Collaborative Information Tech	0	9,060	6,044	5,396	5,523	5,632	5,748	Continuing	TBD
5581	Command and Control (C2) Technology	20,744	18,503	24,366	35,628	36,071	36,422	37,292	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	Continuing	TBD

Note: In FY 2002, portions of efforts in Projects 4519, 4594, and 5581 move into Project 4917 within this PE. In FY 2002, the effort accomplished in Project 4600 moves into PE 0602204F Project 4916 in order to align projects with the Air Force Research Laboratory organizational structure.

(U) A. Mission Description

This program develops the technology base for Air Force Command, Control, and Communications (C3). Advances in C3 are required to increase warfighter readiness by providing the right information, at the right time, anywhere in the world. The program has four projects. The Communication Technology project develops assured, secure communications technology. The Information Technology project develops improved and automated capabilities to generate, process, fuse, exploit, interpret, and disseminate timely and accurate information. The Collaborative Information Technology project develops high payoff emerging technologies for the next generation of distributed, collaborative command and control systems. The Command and Control Technology project investigates and develops planning, assessment, and knowledge base technologies to allow the warfighter to plan, assess, execute, monitor, and re-plan on the compressed time scales required for tomorrow's conflicts. Note: In FY 2002, Congress added \$3.9 million for simulation-based acquisition; \$1.8 million for Information Hiding, Steganography and Digital Watermarking for Information Protection and Authentication Systems; and \$2.3 million for Assured Communications.

Page 1 of 18 Pages Exhibit R-2 (PE 0602702F)
223
UNCLASSIFIED

	RDT&E BUDGET ITEM JUSTIFICA	DATE Febru	ary 2002		
BUDO 02 -	GET ACTIVITY • Applied Research	Communicatior	IS		
(U)	<u>B. Budget Activity Justification</u> This program is in Budget Activity 2, Applied Research, since it de revolutionary technologies.	evelops and determines the technical fea	asibility and militar	y utility of evolutionary	y and
(U)	C. Program Change Summary (\$ in Thousands)				
(U) (U) (U)	Previous President's Budget Appropriated Value Adjustments to Appropriated Value	<u>FY 2001</u> 86,448 87,249	<u>FY 2002</u> 59,672 66,659	<u>FY 2003</u> 67,480	<u>Total Cos</u> t
(0)	 a. Congressional/General Reductions b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram 	-2,048	-98		
(U) (U)	 d. Below Threshold Reprogram e. Rescissions Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR 	-24 -801 84,376	66,561	3,471 70,951	TBD
(U)	<u>Significant Program Changes:</u> Not Applicable.				
		Page 2 of 18 Pages		Exhibit R-2	(PE 0602702F)

BUDGET ACTIVITY PE NUMBER AND TITLE 02 - Applied Research 0602702F Communication FY 2001 Actual FY 2002 FY 2002 Estimate FY 2003 Estimate FY 2004 Estimate FY 2005 Estimate FY 2005 Estimate FY 2007 Estimate FY 2007 Estimate Cost to Complete 4519 Communications Technology 21,784 15,855 16,331 15,251 16,581 17,020 17,476 Continuing Note: In FY 2002, a portion of the effort accomplished in Project 4519 moves into Project 4917. Image: Communications for an agile Expeditionary Aerospace Force (EAF). These communications for an agile Expeditionary Aerospace Force (EAF). These communications for distributed collaborative command and control (C2). A rapidly deplot requires assured connectivity with reliable, responsive, affordable information exchange via all available communications media. This project provid technologies for: multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques; phased array antennas; and modular, programmable, low-cost radios. It includes technologies for advanced processors and devices, advanced network services, intelligent communications management and control, advanced communications algorithms, and enabling communication signal processing (U) FY 2001 (\$ in Thousands) Developed assured and survivable information and networking technologies for globally distributed information operations for EAF. Developed information systems and networking technologies for g	PROJECT 4519 Total Cost TBD unication red EAF s the ightweight, protocols and
COST (\$ in Thousands)FY 2001 ActualFY 2002 EstimateFY 2003 EstimateFY 2004 EstimateFY 2006 EstimateFY 2007 EstimateCost to Complete4519Communications Technology21,78415,85516,33115,25116,58117,02017,476ContinuingNote: In FY 2002, a portion of the effort accomplished in Project 4519moves into Project 4917.17,476Continuing(U)A. Mission Description The Air Force requires technologies that enable assured, worldwide communications for an agile Expeditionary Aerospace Force (EAF). These commute chnologies for: multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques; phased array antennas; and modular, programmable, low-cost radios. It includes technologies for advanced processors and devices, advanced network services, intelligent communications management and control, advanced communications algorithms, and enabling communication signal processing(U)FY 2001 (\$ in Thousands)(U)\$7,224Developed assured and survivable information and networking technologies for globally distributed information operations systems and networking technologies for globally distributed information exchange for the Air Force, in a joint/coa environment. Developed technologies to provide managed, seamless global information exchange for the Air Force, in a joint/coa environment. Developed technologies to i	Total Cost TBD unication ved EAF s the ightweight, protocols and
4519Communications Technology21,78415,85516,33115,25116,58117,02017,476ContinuingNote: In FY 2002, a portion of the effort accomplished in Project 4519 moves into Project 4917.(U) A. Mission Description The Air Force requires technologies that enable assured, worldwide communications for an agile Expeditionary Aerospace Force (EAF). These commutechnologies will provide en-route and deployed reachback communications for distributed collaborative command and control (C2). A rapidly deployed requires assured connectivity with reliable, responsive, affordable information exchange via all available communications media. This project provid technologies for: multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques; phased array antennas; and modular, programmable, low-cost radios. It includes technologies for advanced processors and devices, advanced network services, intelligent communications management and control, advanced communications algorithms, and enabling communication signal processing(U)\$7,224Developed assured and survivable information and networking technologies for globally distributed information exchange for the Air Force, in a joint/coa environment. Developed technologies to provide managed, seamless global information exchange for the Air Force, in a joint/coa environment. Developed technologies to improve quality of service, robustness, security, and survivability of mission-critical	TBD unication red EAF s the ghtweight, protocols and
 Note: In FY 2002, a portion of the effort accomplished in Project 4519 moves into Project 4917. (U) <u>A. Mission Description</u> The Air Force requires technologies that enable assured, worldwide communications for an agile Expeditionary Aerospace Force (EAF). These commutechnologies will provide en-route and deployed reachback communications for distributed collaborative command and control (C2). A rapidly deployed requires assured connectivity with reliable, responsive, affordable information exchange via all available communications media. This project provid technologies for: multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques; phased array antennas; and modular, programmable, low-cost radios. It includes technologies for advanced processors and devices, advanced network services, intelligent communications management and control, advanced communications algorithms, and enabling communication signal processing (U) <u>FY 2001 (\$ in Thousands</u>) (U) \$7,224 Developed assured and survivable information and networking technologies enabling the capability for worldwide command, or communication operations for EAF. Developed information systems and networking technologies for globally distributed information exchange for the Air Force, in a joint/coa environment. Developed technologies to improve quality of service, robustness, security, and survivability of mission-critical 	unication yed EAF s the ghtweight, protocols and
 (U) <u>A. Mission Description</u> The Air Force requires technologies that enable assured, worldwide communications for an agile Expeditionary Aerospace Force (EAF). These commutechnologies will provide en-route and deployed reachback communications for distributed collaborative command and control (C2). A rapidly deployrequires assured connectivity with reliable, responsive, affordable information exchange via all available communications media. This project provide technologies for: multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques; phased array antennas; and modular, programmable, low-cost radios. It includes technologies for advanced processors and devices, advanced network services, intelligent communications management and control, advanced communications algorithms, and enabling communication signal processing (U) <u>FY 2001 (\$ in Thousands</u>) (U) \$7,224 Developed assured and survivable information and networking technologies enabling the capability for worldwide command, or communication operations for EAF. Developed information systems and networking technologies for globally distributed information develop technologies to provide managed, seamless global information exchange for the Air Force, in a joint/coal environment. Developed technologies to improve quality of service, robustness, security, and survivability of mission-critical 	unication ved EAF s the ghtweight, protocols and
 (U) <u>FY 2001 (\$ in Thousands</u>) (U) \$7,224 Developed assured and survivable information and networking technologies enabling the capability for worldwide command, or communication operations for EAF. Developed information systems and networking technologies for globally distributed information exchange for the Air Force, in a joint/coa environment. Developed technologies to improve quality of service, robustness, security, and survivability of mission-critical 	ecnniques.
 (U) \$7,224 Developed assured and survivable information and networking technologies enabling the capability for worldwide command, or communication operations for EAF. Developed information systems and networking technologies for globally distributed information continued to develop technologies to provide managed, seamless global information exchange for the Air Force, in a joint/coa environment. Developed technologies to improve quality of service, robustness, security, and survivability of mission-critical 	
	ontrol and mation systems. tion nformation.
 (U) \$7,307 Developed critical assured communications and signal processing technologies to provide adaptive, covert, anti-jam, and assur battlespace connectivity to aerospace forces and greatly reduce equipment footprint. Continued to develop and apply critical n wideband wireless communications technologies for assured communications in Joint and Coalition environments. (In FY 200 this effort moves into Project 4917.) 	d global ultiband and 2, a portion of
(U) \$7,253 Developed Defensive Information Warfare tools and technologies to ensure information protection and security of sensitive an Force communication and information systems. Continued to develop net visualization tools and attack indicators. Continued automated capability for computer forensics analysis. Developed preemptive indicators, damage assessment, and recovery tec	encrypted Air o develop niques.
(U) \$21,784 Total	-
Project 4519Page 3 of 18 PagesExhibit R-2A	

	RDT&E	BUDGET ITEM JUSTIFICATION SH	EET (R-2A Exhibit)	DATE February 2002				
BUDO 02 -	GET ACTIVITY - Applied Resear	PE Ch 06	NUMBER AND TITLE 02702F Command Control and Co	PROJECT mmunications 4519				
(U)	A. Mission Description	on Continued						
(U) (U)	<u>FY 2002 (\$ in Thousa</u> \$7,561	nds) Develop assured and survivable information and networkin communication operations for Expeditionary Aerospace Fe distributed information systems. Continue to develop assu critical infrastructure attacks. Complete development of te communication technology that will focus on techniques fo of these capabilities within the global information enterpri	ng technologies enabling the capability for worldw brces. Continue to develop technologies to improv red networking and information systems technologies chnologies for assured wireless networking algori or tactical wireless networking, wireless informations se.	ride command, control and ye quality of service for globally gies to improve survivability to thms. Develop assured on assurance, and the management				
(U)	\$3,350	 Big and the ground and ground and ground and signal processing technologies to provide adaptive, covert, anti-jam, and assured global battlespace connectivity to aerospace forces and greatly reduce equipment footprint. Investigate and develop techniques to improve information assurance capabilities for mobile wireless networks to preclude information attacks aimed at denial of service and quality of service degradation. Continue to develop mobile communication technologies for wide-band data and video services to beyond-line-of-sight airborne command and control, and sensor platforms. 						
(U)	\$4,944	Develop Defensive Information Warfare tools and technol Force communication and information systems. Continue systems. Develop computer and network forensics tools. Investigate techniques to perform analysis on detection and	by the ensure information protection and security to develop automated capability for damage assess Develop data mining tools for coordinated informated eradication of malicious software.	y of sensitive and encrypted Air sment and recovery of information ation warfare attack assessment.				
(U)	\$15,855	Total						
(U) (U)	<u>FY 2003 (\$ in Thousa</u> \$6,015	nds) Develop assured and survivable information and networkin operations for the Global Strike Task Force. Continue to c information systems. Complete development of assured ne infrastructure attacks. Initiate development of securely ma multiple network security domains. Initiate development of advanced information delivery services, independent of the	ng technologies enabling worldwide command, co evelop technologies to improve quality of service etworking and information systems technologies to naged enterprise network technology to develop a of programmable networking algorithms that enable e underlying physical infrastructure devices.	ntrol and communication for globally distributed o improve survivability to critical ssured network services across le the dynamic creation of				
(U)	\$4,734	Develop critical assured communications and signal proce battlespace connectivity to aerospace forces and greatly re assurance capabilities for mobile wireless networks to prec	ssing technologies to provide adaptive, covert, ant duce equipment footprint. Continue to develop tec lude information attacks aimed at denial of service	i-jam, and assured global chniques to improve information e and quality of service				
Р	Project 4519	Page 4 of	18 Pages	Exhibit R-2A (PE 0602702F)				
		22	26					

	RDT&E	DATE February 2002	
BUD 02	GET ACTIVITY - Applied Resear	PE NUMBER AND TITLE Ch 0602702F Command Control and Cor	PROJECT mmunications 4519
(U)	A. Mission Descripti	on Continued	
(U)	<u>FY 2003 (\$ in Thousa</u>	<u>nds</u>) <u>Continued</u> degradation. Develop assured communication technologies that will enable a full spectrum of information su networks in a joint/coalition environment. Investigate high performance wireless device and waveform techr affordability of critical Air Force command and control networks.	periority capabilities in wireless ologies for improving
(U)	\$5,582	Develop Defensive Information Warfare tools and technologies to ensure information protection and security Force communication and information systems. Continue to develop automated capabilities for damage asses Continue to develop computer and network forensics tools and data mining tools to assess coordinated inform Continue to develop detection and eradication techniques for malicious software. Initiate investigations in ac detection of hidden data, and early assessment of complex IW attacks.	of sensitive and encrypted Air ssment and recovery techniques. nation warfare (IW) attacks. ctive response technologies,
(U)	\$16,331	Total	
(U)	<u>B. Project Change S</u> Not Applicable.	<u>immary</u>	
(U) (U) (U) (U)	C. Other Program F Related Activities: PE 0603789F, C3I Ac This project has been	inding Summary (\$ in Thousands) vanced Development. coordinated through the Reliance process to harmonize efforts and eliminate duplication.	
(U)	D. Acquisition Strate Not Applicable.	gy	
(U) (U)	E. Schedule Profile Not Applicable.		
F	Project 4519	Page 5 of 18 Pages	Exhibit R-2A (PE 0602702F)

Γ	RDT&	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
вирс 02 -	BET ACTIVITY Applied Reseat	rch			PE NUMBE 0602702	r and title 2F Comi	mand Co	ntrol and	- I Commu	inication	PROJECT S 4594
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4594	Information Techno	blogy	31,601	23,143	24,210	24,492	24,722	25,389	26,071	Continuing	TBD
Note	 in the information is fused to support the dynamic planning and execution cycle via the global information enterprise. Knowledge, information, and data are archived in the global information base for continued use and historical analysis. The information technologies required to achieve this capability are daveloped under this project in an affordable manner, and include appropriate access mechanisms for our coalition partners. 										
(U) (U)	FY 2001 (\$ in Thous \$4,686	 <u>2001 (\$ in Thousands)</u> <u>586</u> Developed information exploitation technologies for imagery and electronic signals to increase global awareness. Continued to develop multisensor, multimedia analytical techniques to automatically detect and track the presence and location of objects (target, non-targets both civilian and military) and extract changes in the information. Investigated advanced information dissemination techniques for seamless 									
(U)	\$7,390	Developed and evaluated inno and evaluated collaborative m addressing surface, airborne,	ovative mult nultisensor to and spacebo	isensor colla echnologies rne systems	borative fus for near-real in a fully dis	ion technolo -time cueing stributed env	ogies in a ful g and retaski vironment.	ly distribute ng of sensor	d aerospace s for dynami	environment ic fusion of i	. Developed nformation,
(U) (U)	\$4,961 \$2,611	addressing surface, airborne, and spaceborne systems in a fully distributed environment. Developed global information base technologies to achieve situational awareness at all command levels for the dynamic planning and execution process. Developed and investigated technology concepts that employ multiple levels of abstraction to rapidly extract information from globally distributed databases, to provide timely and accurate information to dynamic planning and execution operations. Continued to develop information extraction technology to retrieve data from text and automatically insert into structured formats, enabling the warfighter to process large volumes of text faster and more effectively. Developed embedded, affordable, scalable, teraflop processing technologies for real-time information fusion and exploitation. Developed and evaluated technology for real-time information fusion and exploitation for Expeditionary Aerospace Force situational awareness that is 100									
Р	roject 4594			Page	6 of 18 Pag	es		processing s	узієнія. Ех	(hibit R-2A	(PE 0602702F)

	RDT&	DATE February 2002		
BUD(02 ·	GET ACTIVITY - Applied Resea	rch PE N	JMBER AND TITLE 2702F Command Control and Co	PROJECT mmunications 4594
(U)	A. Mission Descrip	ion Continued		
(U)	<u>FY 2001 (\$ in Thou</u>	ands) Continued		
(U)	\$5,939	Developed information technologies that significantly reduced development of a requirements modeling representation conceverification, and analysis. Completed the research for makin hardware models and battlespace models, enabling more of a 4917.)	the development cost of complex electronic sy isely capturing the engineering requirements fo g digital hardware models more reusable. Deve system to be verified by simulation. (In FY 200	stems. Completed the r computer-aided simulation, lop an interface between digital)2, this effort moves to Project
(U)	\$6,014	Developed modeling and simulation technologies to support developed techniques to expand the capability while reducing National Air and Space Warfare Model. Developed simulating generation distributed collaborative environments.	next generation distributed collaborative environ g the complexity of existing high-resolution more on techniques to provide accurate, real-time dec	nments. Evaluated, exploited, and dels and simulations for the ision support for the next
(U)	\$31,601	Total		
(U)	<u>FY 2002 (\$ in Thou</u>	ands)		
(U)	\$5,485	Develop information exploitation technologies for imagery a multi-sensor open systems techniques and tools for product intelligence products to achieve situation awareness. Develo global information databases.	nd electronic signals to increase global awarene on of imagery (including hyperspectral), electro p advanced information dissemination techniqu	ss. Develop advanced onic signals, and speech es for seamless integration into
(U)	\$5,585	Develop and evaluate innovative multi-sensor collaborative f techniques to quantitatively evaluate fusion algorithms. Dev for the location and identification of military targets, address	usion technologies in a fully distributed aerospa elop and evaluate fusion technologies for multi- ing surface, airborne, and spaceborne systems in	ce environment. Develop platform cross-cueing of sensors a fully distributed environment.
(U)	\$6,047	Develop global information base technologies to achieve situ process. Investigate information extraction techniques to aut synthesizing a common data representation from multiple so retrieval techniques for improved sensor data exploitation an	ational awareness at all command levels for the omatically populate very large knowledge base arces for improved situational awareness. Inves d faster data base access.	dynamic planning and execution systems. Develop approaches for tigate methods of content-based
(U)	\$2,688	Develop affordable, scalable, teraflop processing technologie processor-in-memory, content-addressable architecture for ra architectures to support real-time requirements for dominant	s for real-time information fusion and exploitat pid extraction of information from globally dist battlespace awareness.	ion. Develop ributed knowledge bases. Develop
(U)	\$1,538	Develop modeling and simulation technologies to support ne	xt generation planning, execution, and assessme	ent environments. Evaluate,
F	Project 4594	Page 7 of 1	3 Pages	Exhibit R-2A (PE 0602702F)

	RDT&E	DATE February 2002	
budg 02 -	BET ACTIVITY Applied Researe	Ch PE NUMBER AND TITLE Ch 0602702F Command Control and Control	PROJECT mmunications 4594
(U)	A. Mission Description	on Continued	
(U)	FY 2002 (\$ in Thousa	nds) Continued exploit, and develop model abstraction and multi-resolution modeling techniques to reduce the complexity o and simulations supporting the National Air and Space Model	f existing high-resolution models
(U)	\$1,800	Develop information hiding, steganography and digital watermarking techniques to protect and authenticate information systems. Develop and evaluate steganography detecting and decoding techniques for data embe proofing, image and video content authentication, and secure information dissemination.	data within Air Force and DoD dding, tamper detection and
(U)	\$23,143	Total	
(U)	<u>FY 2003 (\$ in Thousa</u>	<u>nds)</u>	
(U)	\$6,848	Develop information exploitation technologies for imagery and electronic signals to increase global awarene multi-sensor open systems techniques and automated analyst tools for exploiting hyperspectral imagery, on-lectronic signals, and speech intelligence products to achieve improved situational awareness.	ss. Continue to develop advanced board video processing, new
(U)	\$6,578	Develop and evaluate innovative multi-sensor collaborative fusion technologies in a fully distributed aerospa develop techniques to quantitatively evaluate fusion algorithms. Develop multi-source fusion techniques for significant vehicles in the battlespace. Develop and evaluate fusion technologies for enemy threat prediction	ce environment. Continue to continuous tracking of militarily based on multi-source fusion.
(U)	\$5,478	Develop global information base technologies to achieve situational awareness at all command levels for the process. Develop intermediate information extraction techniques to reduce data overload and increase time a decision-making, enabling the ability to populate knowledge base systems. Continue to develop techniques repository, and content-based extraction. Develop advanced web-based search techniques and information a rapid situational understanding.	dynamic planning and execution allocated to analysis and for a self-organizing, data ggregation methods required for
(U)	\$3,429	Develop affordable, scalable, petaflop processing technologies for real-time information fusion and exploitate memory content addressable architecture for rapid extraction of information from globally distributed knowl to support real-time requirements for dominant battlespace awareness.	ion. Complete processor in edge bases. Evaluate architecture
(U)	\$1,877	Develop modeling and simulation technologies to support next generation planning, execution, and assessme evaluate, exploit, and develop model abstraction and multi-resolution modeling techniques to reduce the con models and simulations for next generation distributed collaborative decision support environments, exempli Battlespace.	ent environments. Continue to aplexity of existing high-resolution fied by the Joint Synthetic
(U)	\$24,210	Total	
P	roject 4594	Page 8 of 18 Pages	Exhibit R-2A (PE 0602702F)

	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 2002		
BUD 02 ·	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Co	mmunications	PROJECT 4594
(U)	B. Project Change Summary Not Applicable.			
(U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0603789F, C3I Advanced Development. This project has been coordinated through the Reliance process to harmonize	efforts and eliminate duplication.		
(U)	D. Acquisition Strategy Not Applicable.			
(U) (U)	E. Schedule Profile Not Applicable.			
F	Project 4594 Page	9 of 18 Pages	Exhibit R-2A (PE	0602702F)
		231		

	RDT&I	E BUDGET ITEM JU	STIFIC	ATION \$	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
вира 02 -	GET ACTIVITY • Applied Resea i	rch			PE NUMBE 0602702	r and title 2F Comi	mand Co	ntrol and	l Commu	inication	PROJECT s 4600
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4600	Electromagnetic Te	echnology	10,247	0	0	0	0	0	0	Continuing	TBD
Note	: In FY 2002, Project 4	4600 efforts transferred to PE 0	502204F Pro	oject 4916, ir	n order to ali	gn projects v	with the Air	Force Resea	rch Laborate	ory organizat	tional structure.
(U)	A. Mission Description This project conducts research in electromagnetics and photonics technologies for application to Intelligence, Surveillance, and Reconnaissance (ISR) Systems. Future surveillance, communications, and imagery/information processing systems will require improved technology for the generation, control, processing, and radiation of electromagnetic and optical energy to reduce system cost, improve system sensitivity, and increase processing rates. Promising technologies for improving ISR systems are electromagnetic propagation and scattering (from targets and clutter) and antennas. This project develops technology and control techniques for large phased array antennas, infrared focal plane array technology, and characterizes phenomena for low-observable surveillance.										
(U)	FY 2001 (\$ in Thous	ands)									
(U)	\$3,313	Designed and developed elect develop and evaluate algorith	tromagnetic ms for a dig	technologies ital beam-for	s for advance rmed multib	ed surveillan eam antenna	ce and recor	maissance sy	stems appli	cations. Cor	ntinued to
(U)	\$3,093	Designed and developed anter advanced concepts for large, I	nna concepts lightweight a	s for aerospa arrays. Cont	ce surveillar inued to dev	nce and reco relop and eva	nnaissance a aluate a three	pplications. e-dimension	Continued al optically e	to develop an excited anten	nd evaluate ina array.
(U)	\$3,841	Designed and developed elect atmospheric phenomenology precision targeting, target sign and develop infrared focal pla	tro-optical te effects on ex natures, and one array tec	echnology to stended rang phenomenol hnology.	enable pass e aerospace ogy models,	ive or active sensors. Co , and selecte	targeting of ntinued to d d multifunct	difficult tar evelop turbu ion sensor ta	gets. Investi lence compe rget charact	igated ways ensation tech eristics. Cor	of mitigating niques for ntinued to design
(U)	\$10,247	Total	•								
(U)	FY 2002 (\$ in Thous	ands)									
(U)	\$0	In FY 2002, the effort moves	into PE 060	2204F, Proje	ect 4916.						
(U)	\$0	Total									
(U)	FY 2003 (\$ in Thous	ands)									
(U)	\$0	In FY 2002, the effort moves	into PE 060	2204F, Proje	ect 4916.						
(U)	\$0	Total									
Р	roject 4600			Page	10 of 18 Pag	ges			Ex	hibit R-2A ((PE 0602702F)

	RDT&E BUDGET ITEM JUSTIFICATION	SHEET (R-2A Exhibit)	DATE February	2002
BUD 02 ·	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Co	mmunications	PROJECT 4600
(U)	B. Project Change Summary Not Applicable.			
(U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602204F, Aerospace Sensors. PE 0603203F, Advanced Aerospace Sensors. PE 0603789F, C3I Advanced Development. This project has been coordinated through the Reliance process to harmonize	efforts and eliminate duplication.		
(U)	D. Acquisition Strategy Not Applicable.			
(U) (U)	E. Schedule Profile Not Applicable.			
F	Project 4600 Page	11 of 18 Pages	Exhibit R-2A (PE	0602702F)
		233		

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)							DATE	DATE February 2002		
BUDG 02 -	BET ACTIVITY Applied Resear	ch			PE NUMBE 060270	r and title 2F Comi	mand Co	ntrol and	l Commu	inication	PROJECT s 4917
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4917	Collaborative Inform	nation Tech	0	9,060	6,044	5,396	5,523	5,632	5,748	Continuing	TBD
Note	 Description A. Mission Description To implement the Expeditionary Aerospace Force concept, the Air Force requires a distributed, collaborative command and control (C2) system, allowing the majority of the C2 center to remain in CONUS, 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, 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. Collaboration technologies advance collaboration science, virtual environments, and predictive simulation tools to facilitate the development and fielding of next generation operational collaborative enterprises. Embedded information systems technologies explore high payoff technologies for the next generation of distributed information systems technologies for the next generation of distributed information systems technologies explore high payoff technologies for the next generation integration 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) (U) (U) (U) (U)	 <u>FY 2001 (\$ in Thousands)</u> \$0 The effort was accomplished in Projects 4519, 4594, and 5581 in this PE. \$0 Total <u>FY 2002 (\$ in Thousands)</u> \$1,248 Develop critical information transmission technologies to permit the seamless integration of aerospace weapon systems command and control, intelligence, surveillance, and reconnaissance data/information. Continue to develop assured, secure communications technology, leveraging 							nd and control, gy, leveraging secure.			
(U)	\$2,235	wide-band wireless information was accomplished in Project 4 Develop advanced information assets in response to the conti collaborative planning for Exp	on transfer to 4519.) n technolog nuing chang peditionary	echnology fo ies for collat ing threat er Aerospace F	porative deci nvironment.	sion support Develop tec attlespace inf	ns by multip , knowledge hnologies to formation en	e managemen support dis vironment.	ystems. (Pri nt, and rapid tributed dec: Develop tec	adaptation/r ision making	2, this effort e-allocation of and upport a
P	roject 4917			Page	12 of 18 Pag	ges			E>	hibit R-2A	(PE 0602702F)

	RDT&E	BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2002				
budg 02 -	ET ACTIVITY Applied Researe	PE NUMBER AND TITLE Ch 0602702F Command Control and Cor	mmunications	PROJECT 4917			
(U)	A. Mission Description	on Continued					
(U)	FY 2002 (\$ in Thousa	nds) Continued sensor-to-shooter scenario stressing the time-critical-target requirement, resulting in denying the enemy the s 2002 this effort was accomplished in Projects 5581 and 4594.)	anctuary of time. (Price	or to FY			
(U)	\$1,677	Develop processes, methods, and techniques to provide assured performance, integrity, and security of real-tr systems. Develop dynamically reconfigurable aerospace systems using adaptive computing techniques. Cor designs, and models for the next generation command and control global information systems, which will all development of highly complex aerospace systems, and autonomous unmanned airborne/spaceborne platform time gritical targets. (Dright to EV 2002) this offert was accomplished in Droject 5281.)	ime embedded informa ntinue to develop conce ow affordable design a ns for deployment agai	tion pts, .nd nst			
(U)	 time-critical targets. (Prior to FY 2002, this effort was accomplished in Project 5881.) \$3,900 Develop and assess Simulation Based Acquisition (SBA) technologies for application to integrated aerospace systems design and analysis. Conduct experiments with challenge problems to define the boundaries of SBA capabilities. Develop an enhanced collaborative technology architecture that supports the tenants of SBA 						
(U)	\$9,060	Total					
(U)	FY 2003 (\$ in Thousa	<u>nds)</u>					
(U)	\$1,443	Develop critical information transmission technologies to permit the seamless integration of aerospace weap intelligence, surveillance, and reconnaissance data/information. Complete the development of assured secure leveraging the commercial infrastructure, for positive command and control (C2) of aerospace assets in civili development of secure, wide-band wireless information transfer technology for assured communications betw	on systems' command a e communications tech ian airspace. Continue ween munitions and air	and control, nology, the ccraft.			
(U)	 \$2,570 Develop advanced information technologies for collaborative decision support, knowledge management, and rapid adaptation/re-allocation of assets in response to the continuing changing threat environment. Investigate technology for joint battlespace information environment. Continue to develop technology to support a sensor-to-shooter scenario stressing the time-critical-target requirement, which will result in denying the 						
(U)	\$2,031	Develop processes, methods, and techniques to provide assured performance, integrity, and security of real-ti- systems. Continue to develop dynamically reconfigurable aerospace systems using adaptive computing tech- concepts, designs, and models for the next generation C2 global information systems, which will allow affor- highly complex aerospace systems. Develop methods and processes for determining the suitability of Java a system architectures for real-time, embedded information systems.	ime embedded informa niques. Continue to de dable design and devel- nd Real-Time Java to s	tion velop opment of upport open			
Pr	oject 4917	Page 13 of 18 Pages	Exhibit R-2A (PE	0602702F)			

	RDT&E BUDGET ITEM JUSTIFICATION S	HEET (R-2A Exhibit)	DATE February 2002	
budg 02 -	et activity Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Co	PROJ mmunications 491	ест 7
(U) (U) (U) (U) (U) (U) (U) (U) (U)	A. Mission Description Continued FY 2003 (\$ in Thousands) Continued \$6,044 Total B. Project Change Summary Not Applicable. C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0603789F, C3I Advanced Development. This project has been coordinated through the Reliance process to harmonize of D. Acquisition Strategy Not Applicable. E. Schedule Profile Not Applicable.	efforts and eliminate duplication.		2
Pr	Page 1 Page 1	4 of 18 Pages	Exhibit R-2A (PE 060270	02F)

	RDT&I	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
вира 02 -	BET ACTIVITY Applied Reseau	rch			PE NUMBE 060270	r and title 2F Comi	mand Co	ntrol and	l Commu	inication	PROJECT 5581
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5581	Command and Cor	ntrol (C2) Technology	20,744	18,503	24,366	35,628	36,071	36,422	37,292	Continuing	TBD
Note	: In FY 2002, a portio	n of the effort accomplished in	Project 558	moves into	Project 491	7.					
(U)	The Air Force requires Command and Control (C2) technologies which provide the next generation of weapon systems with improved processing and presentation of information for real-time, distributed battle management. Technologies being developed in this project will increase capability and quality, while reducing the cost of C2 systems and infrastructure. Technology development in this project focuses on planning and assessing techniques, knowledge bases, and distributed information systems. Advances in planning and assessment technologies will vastly improve the military decision making process within C2 systems. Advances in development of very large comprehensive knowledge bases to rapidly formulate and create new knowledge are needed by the Expeditionary Aerospace Force. Advances in distributed intelligent information systems will allow automatic rapid reconfiguration to varying crisis levels required by the Expeditionary Aerospace Force.										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$6,158	ands) Developed the next generatio desired operational effects at measures to create the desired provide alternative courses of	n of plannin the right pla l effects, and f action and f	g and assess ce at the righ l provide nea feasibility as	ment techno nt time. Dev ar-real-time sessment in	logies and to eloped techr command of uncertain en	ools enabling nologies to d forces to ex wironments.	g aerospace o lynamically accute those	commanders assess the ba measures. I	to determine attlespace, de Developed tee	e and create the termine chnologies to
(U)	\$1,963	Investigated and developed technologies for the rapid development and application of next generation knowledge-bases for aerospace C2 systems. Developed tools and techniques needed by an Expeditionary Aerospace Force for building very large comprehensive knowledge bases by rapidly formulating and creating new knowledge, along with capabilities to re-use, augment, and repair existing knowledge-bases. Continued the development of techniques for knowledge-base theory slicing and merging, conflict resolution, and context management. Investigated new techniques to allow users to enter, validate, and manipulate knowledge using natural language, sketching, and templating									
(U)	\$5,908	Investigated, analyzed, and de crisis levels faced by Expedit for current and next generation	eveloped tec ionary Aeros on C2 system	hnologies fo space Forces 18.	or automatic s. Developed	rapid reconf 1 and evalua	iguration of ted advance	distributed i d display and	ntelligent in 1 human-cor	formation sy nputer interf	stems to varying ace technologies
(U)	\$1,979	Developed tools and techniqu new techniques for rapidly in	les to promo	te assured pe new function	erformance and into scales	and affordabi able, open ar	ility of comp chitecture s	olex air and systems. Dev	space platfor veloped dyna	rms. Continu mically reco	ed to develop nfigurable
Р	roject 5581			Page	15 of 18 Pag	ges			Ex	hibit R-2A	PE 0602702F)

	RDT&E	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)							
budo 02 -	GET ACTIVITY • Applied Resear	PE NUMBER AND TITLE Ch 0602702F Command Control and Cor	mmunications	PROJECT 5581					
(U)	A. Mission Descripti	on Continued							
(U)	FY 2001 (\$ in Thousa	nds) Continued aerospace systems using field programmable gate arrays. Developed concepts and preliminary designs for th information systems which will allow the seamless insertion of highly autonomous unmanned airborne and s deployment against time-critical targets. (In FY 2002, this effort moves to Project 4917.)	ne next generation glob paceborne platforms fo	al C2 or					
(U)	\$4,736 Developed the technologies, tools, and techniques required to ensure protection of critical command, control, and communications (C3) infrastructure. Developed the technologies which will allow a robust implementation of an overarching, integrated capability for protection of the global C3 infrastructure. Developed protection techniques with emphasis on integrity of information and availability of networks required for distributed, collaborative command and control (C2) systems.								
(U)	\$20,744	Total							
(U)	FY 2002 (\$ in Thousa	<u>nds)</u>							
(U)	\$5,734	Develop the next generation of planning and assessment technologies and tools enabling aerospace command desired operational effects at the right place at the right time. Continue to develop technologies to dynamical determine measures to create the desired effects, and provide near-real-time command of forces to execute the visualize the probability of success of qualitatively different courses of action. Continue to develop technologies cap various missions, from humanitarian relief to major theater warfare. Develop techniques to enable the rapid C2 information management systems into a battlespace infosphere.	ders to determine and c lly assess the battlespace nose measures. Develo ogies to provide alternationable of supporting C2 insertion of new forces	reate the ce, p tools to tive courses systems for and their					
(U)	\$4,835	Investigate and develop technologies for the rapid development and application of next generation knowledg Develop tools that allow users to enter, validate, and manipulate knowledge using natural language, sketchin Develop knowledge representation techniques to enable the structured common representation (SCR) require Develop capabilities that learn to extract, correlate, and classify link patterns. Investigate enhanced reasonin more complex inferencing and performance.	e bases for aerospace C g, and templating appro- ed for a battlespace info g techniques and algori	22 systems. Daches. Disphere. ithms for					
(U)	\$7,934 Investigate, analyze, and develop technologies for automatic rapid reconfiguration of distributed intelligent information systems to varying crisis levels faced by Expeditionary Aerospace Forces. Develop dynamic and adaptable interface technologies that allow commanders to create a mission-tailored view of the configuration and status of the currently executing Air Operations Center C2 process. Develop advanced interactive displays suitable for deployment with C2 applications and command centers. Develop techniques and applications for information visualization for use in conjunction with multiple, heterogeneous data sets. Develop techniques for integrating legacy client-server C2 systems								
Р	roject 5581	Page 16 of 18 Pages	Exhibit R-2A (PE	0602702F)					
		238							

	RDT&I	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								
BUDO	GET ACTIVITY	PE NUMBER AND TITLE	: 0.0.0.di y /	PROJECT						
02 -	- Applied Resear	ch 0602702F Command Control and Con	mmunications	5581						
(U)	A. Mission Descript	ion Continued								
(U)	FY 2002 (\$ in Thous	ands) Continued into the next generation of agile, web-enabled information management environments. Investigate approach smoothly scale to over 1,000 clients exchanging information using a publish-subscribe paradigm as required	es to enable C2 system for a battlespace infost	s to bhere.						
(U)	\$18,503 Total									
(U)	FY 2003 (\$ in Thousands)									
(U)	\$7,267 Develop the next generation of planning and assessment technologies and tools enabling aerospace commanders to determine and create the desired operational effects at the right place at the right time. Continue to develop technologies to dynamically assess the battlespace, determine measures to create the desired effects, and provide near-real-time command of forces to execute those measures. Continue to develop tools to visualize the probability of success of qualitatively different courses of action. Continue to develop intelligent agent technologies for use in dynamic mobile C2 applications. Develop tools to increase situational awareness through intelligent information push and pull in dynamic environments.									
(U)	\$5,485	Investigate and develop technologies for the rapid development and application of next generation knowledg Continue to develop tools that will automate intelligent extraction, correlation, and classification of link patter linkages between entities. Develop enhanced reasoning techniques for complex inferencing and performance	te bases for aerospace C erns for discovering rel- e of C2 systems.	C2 systems. evant						
(U)	\$7,823	Investigate, analyze, and develop technologies for automatic rapid reconfiguration of distributed intelligent in crisis levels faced by Aerospace Expeditionary Forces. Continue to develop dynamic and adaptable interface commanders to create a mission-tailored view of the configuration and status of the currently executing Air (Continue to develop advanced interactive displays suitable for deployment with C2 applications and comman techniques and applications for information visualization for use in conjunction with multiple, heterogeneous	nformation systems to e technology that allow Operation Center C2 pr nd centers. Continue to s data sets.	varying s ocess. o develop						
(U)	 \$3,791 Investigate and develop technologies to implement flexible, secure and survivable information management and distribution services to enable a Joint Battlespace Infosphere (JBI). Continue to develop techniques for integrating legacy client-server C2 systems into the next generation of agile, web-enabled information management environments. Continue to investigate approaches to enable JBI to service thousands of participating C2 and intelligence, surveillance, and reconnaissance clients exchanging millions of information objects. Investigate and develop technologies that will ensure availability integrity and survivability of information within a IBI 									
(U)) \$24,366 Total									
P	Project 5581	Page 17 of 18 Pages	Exhibit R-2A (PE	0602702F)						
		239								

	RDT&E BUDGET ITEM JUSTIFICATION S	SHEET (R-2A Exhibit)	DATE February 2002				
BUD(02 -	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Co	mmunications	PROJECT 5581			
(U)	B. Project Change Summary Not Applicable.						
(U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) 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)	D. Acquisition Strategy Not Applicable.						
(U) (U)	E. Schedule Profile Not Applicable.						
F	Project 5581 Page	18 of 18 Pages	Exhibit R-2A (PE	0602702F)			
	240						

	RDT&	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)									DATE February 2002	
вира 02 -	GET ACTIVITY • Applied Resear	ch			PE NUMBE	r and title 5F Dual	Use Scie	ence & Te	chnol	PROJECT ology 4770		
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost	
4770	Dual Use Science a	and Technology (S&T)	9,717	10,316	10,626	10,820	11,031	11,242	11,4	55 Continuing	TBD	
	Quantity of RDT&E	Articles	0	0	0	0	0	0		0 0	0	
(U)	J) <u>A. Mission Description</u> The Dual Use Science and Technology program seeks to leverage industry investments and interests in advanced technologies of mutual advantage to the Air Force and industry. A key objective of this program is for the Air Force to stimulate the development of dual use technologies so as to provide greater access to commercial technologies and to lead to affordable defense systems that maintain battlefield superiority. A critical component of the program is the cost-sharing requirement from both industry and the Air Force. The cooperative funding assures joint commitment to the development effort of successful transitions. Specific projects are determined through annual competitive solicitation(s). Technology areas considered include advanced materials and manufacturing; sensors; advanced propulsion, power, and fuel efficiency; information and communications technologies; and weapon systems sustainment.											
(U) (U)	 <u>FY 2001 (\$ in Thousands</u>) \$1,802 Developed advance materials and manufacturing technologies that will reduce the cost and improve the capability of both Air Force and commercial air and space vehicles and launch systems. Technology areas considered included: growth processes for wide bandgap semiconductor materials such as Silicon Carbide (SiC), Gallium Nitride (GaN), and related materials; superior ceramic matrix composites (CMCs); advanced metal matrix composites (MMCs) and intermetallics materials for durable, maintainable vehicles; composite material structures based upon low-cost preforming, infusion, and curing; and inflatable membrane solar concentrators for high powered (>100kW) military and commercial satellites. \$1,264 Developed affordable advanced sensors technologies that can be applied to both commercial and military space and airborne systems to provide a complete and timely picture of the battlespace, enable a timely precision response, and enhance the warfighter's survivability, as well as 											
(U) P	\$4,578 Project 4770	shape, cost-effective to manual provide precise and timely top and navigation aids, including Developed advanced propulsi airbreathing and rocket propu	facture, oper pographical g inertial nav on, power, a lsion system	ate over a ve maps for bot igation com nd fuel effic is. Technolo Page	ery wide free th commerci ponents and tiency techno ogy areas cor e 1 of 6 Page	uency band al and milita satellite-bas blogies that insidered incl	width, and a ry purposes ed global po improve the ude: advanc	re polarizations i innovative ositioning. performance ed gas turbir	on divers focal plan , increase ne combu	e; laser radar (I he arrays (FPAs e life, and reduc stion; cost-effe Exhibit R-2	LADAR) to s) for LADAR; ce emissions of ctive, long life, (PE 0602805F)	

		DATE February 2002							
BUDGE 02 - /	ET ACTIVITY Applied Resear	ch	PE NUMBER AND TITLE 0602805F Dual Use Science & Techn	PROJECT ology 4770					
(U) <u>A</u>	A. Mission Descripti	on Continued							
(U) <u>I</u>	FY 2001 (\$ in Thousa	nds) Continued							
(U) S	 \$1,399 \$1,399 beveloped information and communication systems technologies that enhance human-vehicle interactions, improve the capability of aerospace command and control, advance information dominance and battlefield management, as well as enhance commercial communications and awareness. Technology areas considered included: automation of logistics and equipment failure reporting; information recovery; intelligent image correlators: smart data processing: and web-based virtual consortiums for modeling. 								
(U) S	 information systems; information fusion; intelligent image correlators; smart data processing; and web-based virtual consortiums for modeling and simulation research/application. beveloped weapon systems sustainment technologies that extend the life and improve the performance, effectiveness, and reliability of both Air Force and commercial air and space vehicles. Technology areas considered include: computational methods for assembling and validating system maintenance instructions; on-board aircraft generation and liquefaction of oxygen and nitrogen; structural integration of subsystems to reduce weight and cost; design tools; and cost-effective techniques for monitoring system health. 								
U) I	FY 2002 (\$ in Thousa	nds)							
(U) \$	\$2,606	Develop information technologies to ensure the collect decision-makers and corresponding commercial industr providing for the fusion, accuracy, security, and transm understood manner to a decision maker.	ion, dissemination, security, accuracy, and presentatio ry sectors. Technology areas considered include gath ission of information; and presenting the information	n of information to U.S. military ering of pertinent information; in a consistent and easily					
(U) S	 \$2,570 \$2,570 Develop innovative techniques and processes for non-destructive inspection, evaluation, and maintenance of Air Force and commercial aircraft assets. These techniques and processes are relevant to enable critical maintenance and repair decisions by depot and flight line maintenance personnel. The focus is on refinement and optimization of inspection, evaluation, and prediction techniques for maintenance and troubleshooting. Technology areas include inspection, evaluation, and maintenance of avionics, propulsion, structures, flight controls, and expendables such as fuels, lubricants, and hydraulic fluid; application of these new techniques to in-flight monitoring and early warning indicate processes are responsed as descent of a structure of a structure of a structure of the st								
(U) S	\$2,570	Develop affordable, robust manufacturing processing a system applications. The technology will also support aircraft, missiles, space systems, or other defense relate	nd fabrication techniques for metals and special mater commercial applications and significantly impact the d applications. Technology areas considered include	ials critical to defense weapon cost and performance of future more efficient and affordable					
Pro	oject 4770	Page	2 of 6 Pages	Exhibit R-2 (PE 0602805F)					

	RDT&	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							
BUDO	GET ACTIVITY	ch	PE NUMBER AND TITLE	PROJECT					
02 -	A Mission Description		boozoosi Dual ose science a recim						
(0)	A. Mission Descripti	on Conunued							
(U)	FY 2002 (\$ in Thousa	nds) Continued manufacturing processes/components, part count reduc times, improved inspection techniques, and advanced	tion techniques, improved yields, improved process/d prototyping techniques.	imensional control, reduced lead					
(U)	\$1,300 Develop and demonstrate advanced power generation, power conditioning, energy conversion, energy storage, thermal management and power distribution component and system technologies for space applications. Military and commercial applications include satellites, energy storage, power distribution and conditioning, and thermal management systems. The focus is on enabling power generation improvements in efficiency, volume, mass, life, and reliability. The goal is to demonstrate significant improvements in size, weight, and reliability over state-of-the-art systems and/or enable new concepts.								
(U)	\$1,270 Develop and demonstrate advanced power generation, power conditioning, energy conversion, energy storage, thermal management, and power distribution technologies for More Electric Aircraft military and civilian use. Applications include commercial aircraft, inhabited and uninhabited aircraft, and airborne directed energy weapons. Technologies of interest include aircraft power components and systems that demonstrate significant improvements in size, weight, and reliability over-state-of-the-art systems and/or enable new concepts. The focus is on improvements in reliability, maintainability, commonality, and supportability. Technology areas considered include concepts to replace hydraulic, mechanical and pneumatic power subsystems and their costly logistics support; compact high power generation and conditioning; and high rate energy storage.								
(0)	\$10,510	Totai							
(U) (U)	<u>FY 2003 (\$ in Thousa</u> \$2,126	nds) Develop advance materials and manufacturing technolo and commercial air and space vehicles and launch syst techniques; smart and adaptive skins; corrosion resista launch; and agile materials for use in force protection.	ogies that will reduce the life-cycle cost while enhanci ems. Technology areas of interest include: non-destru nt coatings; micro and nano-scale electronics; durable	ing the capability of both Air Force active/non-intrusive evaluation e, light weight materials for space					
(U)	\$2,125	Develop affordable advanced sensors technologies that interest include: timely, high quality, precision imaging speed, precision temporal, spatial, and attitude sensors	t have application to commercial and military aerospace; sensitive, ambient environment electromagnetic (i.e. and controllers.	ce platforms. Technology areas of, infrared) detection; and high					
(U)	\$2,125	Develop advanced propulsion, power, and fuel efficien military and commercial aerospace operations. Techno propulsion systems; advanced gas turbine combustion	cy technologies to improve the performance, increase ology areas of interest include: performance and emiss and blades; electric propulsion alternatives; energy pro-	the life, and reduce the cost of sions of airbreathing and rocket occessing, storage, and conversion;					
Р	roject 4770	Page	3 of 6 Pages	Exhibit R-2 (PE 0602805F)					

	RDT&E BUDGET ITEM JUSTIFICATIO	DATE Febru	ary 2002		
BUDO	GET ACTIVITY	PE NUMBER AND TITLE		8	PROJECT
02 -	- Applied Research	0602805F Dual Use	Science & Te	chnology	4770
(U)	A. Mission Description Continued				
(U)	FY 2003 (\$ in Thousands) Continued				
(U)	 \$2,125 \$2,125 Develop advanced information and communication presentation of information to U.S. and coalition of interest include: collecting, synthesizing, and e security, and transmission of information; and premanner. 	ques. on technologies to enhance the coll military decision-makers and corre encoding of pertinent information; esenting the appropriate informatio	ection, processing, esponding commerc securing the high-sp n in an efficient, tin	dissemination, security ial industry sectors. To beed and reliable fusion nely, consistent, and ea	y, accuracy, and echnology areas n, accuracy, asily understood
(U)	\$2,125 Develop weapon systems sustainment technologi of both Air Force and commercial aerospace syst cost-effective techniques for non-invasive, real-ti	es that extend the life and improve ems. Technology areas of interest me monitoring of system health/pe	the performance, et include: avionics; n	fficiency, reliability, an naterials fatigue and fr ociated environmental	nd maintainability acture; corrosion; impacts.
(U)	\$10,626 Total				r
(U)	<u>B. Budget Activity Justification</u> This program is in Budget Activity 2, Applied Research, since it develop revolutionary technologies.	ps and determines the technical fea	sibility and military	utility of evolutionary	⁷ and
(U)	C. Program Change Summary (\$ in Thousands)				
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>
(U) (U)	Previous President's Budget	10,051	10,417	10,652	
(\mathbf{U})	Adjustments to Appropriated Value	10,144	10,417		
(0)	a Congressional/General Reductions		-101		
	b Small Business Innovative Research	-238	101		
	c. Omnibus or Other Above Threshold Reprogram	200			
	d. Below Threshold Reprogram	-96			
	e. Rescissions	-93			
(U)	Adjustments to Budget Years Since FY 2002 PBR			-26	
(U)	Current Budget Submit/FY 2003 PBR	9,717	10,316	10,626	TBD
Р	Project 4770	Page 4 of 6 Pages		Exhibit R-2	2 (PE 0602805 <u>F)</u>
		244			

	RDT&E BUDGET ITEM JUSTIFICATIO	N SHEET (R-2 Exhibit)	DATE February 2002
BUD0 02 -	GET ACTIVITY • Applied Research	PE NUMBER AND TITLE 0602805F Dual Use Science & Techn	ology 4770
(U)	C. Program Change Summary (\$ in Thousands) Continued		
(U)	<u>Significant Program Changes:</u> Not Applicable.		
	D. Execution - Not Applicable.		
	 D. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0601102F, Defense Research Sciences. PE 0602102F, Materials. PE 0602201F, Aerospace Flight Dynamics. PE 0602202F, Human Effectiveness. PE 0602203F, Aerospace Propulsion. PE 0602204F, Aerospace Sensors. PE 0602601F, Space Technology. PE 0602602F, Conventional Munitions. PE 0602605F, Directed Energy Technology. PE 0602805N, Dual Use Science and Technology (\$&T). PE 0602805A, Dual Use Science and Technology (\$&T). PE 0603203F, Advanced Materials for Weapon Systems. PE 0603211F, Aerospace Structures. PE 0603216F, Aerospace Propulsion and Power Technology. PE 0603210F, Conventional Mersonnel Protection Technology. PE 0603210F, Advanced Spacecraft Technology. PE 0603605F, Advanced Weapons Technology. PE 0603605F, Advanced Weapons Technology. 		
F	Project 4770	age 5 of 6 Pages	Exhibit R-2 (PE 0602805F)

	RDT&E BUDGET ITEM JUSTIFICATIO	N SHEET (R-2 Exhibit)	DATE February 2002				
bud 02	GET ACTIVITY - Applied Research	PE NUMBER AND TITLE 0602805F Dual Use Science & Techr	PROJECT 1000gy 4770				
(U) (U) (U)	D. Other Program Funding Summary (\$ in Thousands) PE 0603789F, C3I Advanced Development. This program has been coordinated through the Reliance process to harmonic	onize efforts and eliminate duplication.					
(U)	E. Acquisition Strategy Not Applicable.						
(U) (U)	F. Schedule Profile Not Applicable.						
F	Project 4770	Page 6 of 6 Pages	Exhibit R-2 (PE 0602805F)				
	246 UNCLASSIFIFD						

	RDT&	E BUDGET ITEM J	USTIFIC	ATION	SHEET	(R-2 E)	chibit)		DATE	Februa	ry 2002
BUDG 03 -	ET ACTIVITY Advanced Tech	nology Development			PE NUMBE	r and title 6F Logis	stics Sys	tems Tec	hnology		PROJECT 2745
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2745	Logistics Performar (S&T)	nce and Support Technology	13,157	0	0	0	0	0	0	Continuing	TBD
	Quantity of RDT&E	Articles	0	0	0	0	0	0	0	0	0
Note: (U)	 Note: In FY 2002, efforts transferred to PE 0603231F, Project 4923, to align resources with the Air Force Research Laboratory organization. (U) <u>A. Mission Description</u> This program develops and demonstrates cost-effective technologies to improve the design, performance, security, and support of current and future weapon systems, including their support equipment. This effort also develops technology to incorporate human operator, maintenance, and support considerations into the weapon systems design process and to make engineering, product support, and maintenance data electronically available throughout weapon systems' life cycles. The program provides more realistic logistics planning and combat capability assessment tools, and provides technologies to reduce deployment airlift and footprint requirements, acoustic sensor and processing technologies to locate and identify threats, and two-way communication technologies for command and control. This program improves logistics information command and control and asset visibility, provides critical logistics risk reduction technology, and helps control total weapon systems' 										
(U) (U) (U)	 Intercycle costs. EY 2001 (\$ in Thousands) \$1,863 Developed and demonstrated technologies to enhance and streamline aircraft maintenance 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. Continued development of diagnostics capability to provide technicians with more effective tools for isolating faults on the software intensive, reconfigurable systems found on modern aircraft and advanced aircraft systems currently in development. \$4,683 Developed and demonstrated intelligent software agents and realistic human behavior models. Developed intelligent software agents that automatically translate and execute air tasking order inputs for synthetic exercises and war games. Developed software agents that enhance the users' ability to monitor and respond to asymmetric events during the planning and scheduling of airlift missions. \$4,549 										
P	roject 2745	rapid access to real-time reso develop an integrated, easily o	arces status i deployable,	information, waste manag Page	proactive progement syste e 1 of 3 Page	roblem ident m to process	ification, de	ision suppo waste mater	rt, and proce rials produce	ess tracking. ed during dep Exhibit R-2 (Continued to bloyed (PE 0603106F)

	RDT&E BUDGE	DATE Febr	uary 2002							
BUDO 03 -	GET ACTIVITY - Advanced Technology Dev	elopment	PE NUMBER AND TITLE	stics Systems Tec	chnology	PROJECT 2745				
(U)	A. Mission Description Continued									
(U)	FY 2001 (\$ in Thousands) Continued operations.									
(U)	 U) \$2,062 Developed and demonstrated logistics technologies for improved system supportability, deployability, and mobility. These technologies greatly improve the flexibility and deployability of the flightline maintenance equipment, improve the airlift/mobility operations of the Air Expeditionary Force, and ensure that weapon systems are more reliable and maintainable. Completed and transitioned specifications for the next generation of powered support equipment for more agile/lean flightline maintenance. Completed and transitioned specifications and technology for next generation ground refueling systems to support Air Force Special Operations Command 									
(U)	\$13,157 Total									
(U)	FY 2002 (\$ in Thousands)									
(U)	\$0 Effort moved to	PE 0603231F, Project 4923	3.							
(U)	\$0 Total									
(U)	FY 2003 (\$ in Thousands)									
(U)	\$0 No Activity									
(U)	\$0 Total									
(U)	<u>B. Budget Activity Justification</u> This program is in Budget Activity 3, performance, and support of current and	Advanced Technology Devended future weapon systems.	lopment, since it develops and der	nonstrates cost-effective	technologies to impro	ove the design,				
(U)	C. Program Change Summary (\$ in	Thousands)								
			<u>FY 200</u>	<u>)1</u> <u>FY 2002</u>	<u>FY 2003</u>	Total Cost				
(U)	Previous President's Budget		13,76	8 0	0	TBD				
(U)	Appropriated Value		13,89	5 0						
(U)	Adjustments to Appropriated Value									
	a. Congressional/General Reductions		22	~						
	b. Small Business Innovative Research		-32	6						
	d Below Threshold Reprogram	reprogram	28	5						
	a. Below Theshold Reprogram		-20	5						
Р	Project 2745		Page 2 of 3 Pages		Exhibit R	-2 (PE 0603106F)				
			248							

BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT D3 - Advanced Technology Development D603106F Logistics Systems Technology 2745 D3 - Advanced Technology Development D603106F Logistics Systems Technology 2745 U C.Proeram Change Summary (\$ in Thousands) Continued FY 2001 FY 2002 FY 2003 Total Cost e. Rescissions -127 100 Total Cost -127 00 TBD UC Current Budget Submit(FY 2003 PBR 13,157 0 0 TBD US Significant Program Changes: In FY 2002, efforts transfer to PE 0603231F, Project 4923, to align resources with the Air Force Research Laboratory organization. U Define Torgram Funding Summary (\$ in Thousands) UB Related Activities: IP 10002201F, Aerospace Flight Dynamics. IP 10002201F, Aerospace Flight Dynamics. IP 10002201F, Marce Flectiveness Applied Research. UP FE 00603701F, Integrated Command & Control Applications. IP 100004740F, Integrated Command & Control Applications. IP 100004740F, Integrated Command & Control Applications. UP E 10005801A, Programwide Activities. U PS 0604740F, Integrated Command & Control Applications. IP 1000011F, Industrial Preparedness. UD FE 0060301A, Programwide Activities. U PS 0604740F, Integrated Command & Control Applicat		RDT&E BUDGET ITEM JUSTIFICATION	DATE Feb	ruary 2002			
VI C.Program Change Summary (5 in Thousands) Continued FY 2001 FY 2002 FY 2003 Total Cost u Adjustments to Budget Years Since FY 2002 PBR -127 0 0 TBD U) Adjustments to Budget Years Since FY 2002 PBR 13,157 0 0 TBD U) Significant Program Changes: 13,157 0 0 TBD U) Significant Program Funding Summary (5 in Thousands) Rescurves with the Air Force Research Laboratory organization. 0 Deter Program Funding Summary (5 in Thousands) U) Related Activities: 0 Other Program Funding Summary (5 in Thousands) 8 U) PE 06002201F, Hornspace Flight Dynamics. 0 PE 060470F, Integrated Command & Control Applications. 0 9	BUDO 03 -	BET ACTIVITY Advanced Technology Development	PE NUMBER AN	D TITLE Logistics	Systems Techn	ology	PROJECT 2745
 e. Rescissions -127 Adjustments to Budget Years Since FY 2002 PBR 13,157 0 0 TBD Significant Program Changes: In FY 2002, efforts transfer to PE 0603231F, Project 4923, to align resources with the Air Force Research Laboratory organization. D. Other Program Funding Summary (S in Thousands) Related Activities: PE 0602201F, Acrospace Flight Dynamics. PE 0602201F, Acrospace Flight Dynamics. PE 0602201F, Acrospace Flight Dynamics. PE 0602721N, Environmental Protection. PE 0604740F, Integrated Command & Control Applications. PE 0708011F, Industrial Preparedness. This project tas been coordinated through the Reliance process to harmonize efforts and eliminate duplication. U Exchedule Profile Not Applicable. 	(U)	C. Program Change Summary (\$ in Thousands) Continued		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>
Project 2745 Page 3 of 3 Pages Exhibit R-2 (PE 0603106F)	(U) (U)	e. Rescissions Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR		-127 13,157	0	0	TBD
Project 2745 Page 3 of 3 Pages Exhibit R-2 (PE 0603106F)	(U)	Significant Program Changes: In FY 2002, efforts transfer to PE 0603231F, Project 4923, to align resources	with the Air For	rce Research I	Laboratory organizatio	n.	
(U) F. Schedule Profile (U) Not Applicable. Project 2745 Page 3 of 3 Pages Exhibit R-2 (PE 0603106F)	(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	 D. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602201F, Aerospace Flight Dynamics. PE 0602202F, Human Effectiveness Applied Research. PE 0603721N, Environmental Protection. PE 0604708F, Civil, Fire, Environmental, Shelter. PE 0604740F, Integrated Command & Control Applications. PE 0605801A, Programwide Activities. PE 0708011F, Industrial Preparedness. This project has been coordinated through the Reliance process to harmonize of E. Acquisition Strategy Not Applicable. 	efforts and elimi	nate duplicati	on.		
Project 2745Page 3 of 3 PagesExhibit R-2 (PE 0603106F)	(U) (U)	<u>F. Schedule Profile</u> Not Applicable.					
	P	roject 2745 Page	3 of 3 Pages			Exhibit F	R-2 (PE 0603106F)

THIS PAGE INTENTIONALLY LEFT BLANK

PE TITLE: Advanced Materials for Weapo	on Systems
--	------------

	RDT&E BUDGET ITEM J	USTIFIC	CATION	SHEET	(R-2 E)	(hibit)		DATE	Februa	ary 2002
BUDGE7 03 - /	BUDGET ACTIVITY PE NUMBER AND TITLE 03 - Advanced Technology Development 0603112F Advanced Materials for Wea							r Weapc	n Systen	ns
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	41,815	45,801	21,138	41,486	42,684	41,255	42,195	Continuing	TBD
2100	Laser Hardened Materials	10,022	23,251	12,359	30,473	30,534	28,815	30,596	Continuing	TBD
3153	Non-Destructive Inspection Development	10,099	6,692	3,488	3,819	4,153	4,233	4,313	Continuing	TBD
3946	Materials Transition	21,694	14,458	3,173	5,256	5,582	5,746	4,779	Continuing	TBD
4918	Deployed Air Base Demonstrations	0	1,400	2,118	1,938	2,415	2,461	2,507	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: In FY 2002, the deployed air base demonstration efforts in PE 0603205F, Project 4398, and PE 0603112F, Project 3946, are transferred into this PE in Project 4918. In FY 2003, only the space unique tasks in Projects 2100 and 3946 will be transferred to PE 0603500F, Project 5032, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) <u>A. Mission Description</u>

This program develops and demonstrates materials technology for transition into Air Force systems. The program has four projects which: (1) develop laser hardened materials technologies for the broadband laser protection of aircrews and sensors; (2) develop non-destructive inspection and evaluation technologies; (3) develop transition data on structural and non-structural materials for aerospace applications; and, (4) develop airbase operations technologies including power generators, deployable shelters, and fire fighting capabilities. Note: In FY 2002, Congress added \$1.1 million for Metals Affordability Initiative, \$3.4 million for advanced aluminum aerostructures, \$2.8 million for ceramic matrix composites for engines, \$2.1 million for technology development investment for aging aircraft, \$2.1 million for plasma enhanced chemical deposition techniques, \$1.0 million for vapor growth carbon fiber (VGCF), and \$1.0 million for handheld holographic radar gun which explains the perceived decrease in FY 2003.

Page 1 of 15 Pages

	RDT&E BUDGET ITEM JUSTIFICATION	DATE Februa	DATE February 2002			
вира 03 -	GET ACTIVITY Advanced Technology Development	PE NUMBER AI	ND TITLE Advanced	d Materials for W	leapon Syster	ns
(U)	<u>B. Budget Activity Justification</u> This program is in Budget Activity 3, Advanced Technology Development, s system developments that have military utility and address warfighter needs.	ince it develops	and demonstra	ates technologies for e	kisting system upgra	ades and/or new
(U) (U) (U) (U)	C. Program Change Summary (\$ in Thousands) Previous President's Budget Appropriated Value Adjustments to Appropriated Value a. Congressional/General Reductions b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram a Resentions		<u>FY 2001</u> 43,575 43,978 -1,032 -728 402	<u>FY 2002</u> 32,748 46,248 -447	<u>FY 2003</u> 25,734	<u>Total Cost</u>
(U) (U)	e. Rescissions Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR Significant Program Changes:		-403 41,815	45,801	-4,596 21,138	TBD
(U)	Significant Program Changes: In FY 2003, only the space unique tasks in Projects 2100 and 3946 will be tra recommendation to consolidate all space unique activities. Additionally, in F decrease in FY 2003.	ansferred to PE FY 2002, this pro	0603500F, Pro ogram received	ject 5032, in conjuncti d Congressional Adds	on with the Space C which explains the j	Commission perceived
	Page	2 of 15 Pages			Exhibit R-2	(PE 0603112F)

	RDT&	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUD(03 ·	GET ACTIVITY - Advanced Tec	chnology Development			PE NUMBE 060311	r and title 2F Adva	nced Ma	terials fo	r Weapo	n System	PROJECT
	COST (\$) in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2100	Laser Hardened I	Materials	10,022	23,251	12,359	30,473	30,534	28,815	30,596	Continuing	TBD
Note cons	: In FY 2003, space olidate all space uniq	unique tasks in Project 2100 will ue activities.	be transferr	ed to PE 060)3500F, Proj	ect 5032, in	conjunction	with the Spa	ace Commis	sion recomm	endation to
(U)	J) <u>A. Mission Description</u> Develops enabling materials and concepts for protecting Air Force assets such as aircrews, munitions, and aerospace sensors against laser and high power microwave directed energy threats. Concepts are demonstrated to provide hardening options for transition to Air Force systems. The goal is to ensure mission capability before, during, and after threat exposure. Current protection schemes are activated by intensity or wavelength and are only capable of countering a specific portion of the laser threat. Recent laser technology development has increased laser wavelength agility. To harden systems against all potential lasers the development of a combination of approaches is required.										
(U)	<u>FY 2001 (\$ in Thou</u>	<u>isands</u>)	advanced m	atomiala taab	nologias the	t anhanaa la	an handanin	a of Ain Eon	a crace a craft	concorre to a	noun cofot.
(0)	\$1,448	survivability, and operability focal plane arrays. Fabricated hardening solutions for critica	in a laser the d rugate fixe al space sens	eat environi d-wavelengt or designs a	nologies than nent. Fabric th filters and nd environm	cated and char optical swite ants based of	aracterized h ches for mid	ybrid optica -wave infrar approaches	l limiters for ed (MWIR) employed in	the protections to e space system n tactical sen	on of staring ns. Developed sors.
(U)	\$5,077	Developed and demonstrated enable aircrews to perform re panoramic night vision goggl (eye-glasses). Developed pre lenses with dved plastic subst	advanced m quired missi es (PNVG). scription cap rates.	aterials tech ons in a lase Evaluated t pable flexibl	nologies tha er threat envi unable filter e filter for eg	t enhance las ronment. De PNVG prote ye protection	ser hardening eveloped fix ection techno n. Transition	g for Air For ed filters and plogy. Valic red prescript	ce aircrews d invisible la lated wrap-a ion-capable,	to ensure saf user eye prote round tristim eye-centered	ety and to ection visor for nulus spectacles d rugates on
(U)	 \$3,497 Developed and demonstrated advanced materials technologies that enhance laser hardening for sensors, avionics, and components to increase survivability and mission effectiveness of air vehicles systems. Fabricated high performance rugate filters for hardened low light level television systems. Initiated development of specific hardening techniques for specific munitions. Developed specific hardening techniques for MWIP and long wave infrared staring forward looking infrared systems. 										
(U)	\$10,022	Total	·	~	U						
F	Project 2100			Page	3 of 15 Pag	es			Ex	hibit R-2A (PE 0603112F)
	253										

	RD	DATE February 2002							
вира 03 -	GET ACTIVITY - Advanced T	echnology Development	PE NUMBER AND TITLE 0603112F Advanced Materials fo	PROJECT r Weapon Systems 2100					
(U)	A. Mission Desc	ription Continued							
(U)	<u>FY 2002 (\$ in T</u>	<u>nousands)</u>	technologies that enhance losse handening of Air Fores a						
(U)	Develop and demonstrate advanced materials technologies that enhance laser hardening of Air Force spacecraft sensors to ensure safety, survivability, and operability in a laser threat environment. Design and fabricate optical limiters for the protection of mid-wave infrared staring focal plane arrays. Test and update hardened coating process for rugate fixed-wavelength filters and optical switches for mid-wave infrared space systems. Fabricate hardening solutions for critical space sensor desings and environments based on successful approaches employed in tactical sensors								
(U)) \$9,046 Develop and demonstrate advanced materials technologies that enhance laser hardening for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in a laser threat environment. Fabricate and validate flexible filter technology (rugate and enhanced thin films) in prescription capable spectacles. Demonstrate first generation tristimulus filter technology (enhanced thin films combined with absorbing dyes) for daytime missions. Complete and transition both flexible filters and tristimulus filters in wraparound spectacles for human factors evaluations. Demonstrate laser protective fixed filters for the panaromic night vision night goggle (PNVG) program. Begin								
(U)	\$8,569	Develop and demonstrate advanced materials survivability and mission effectiveness of area resistant image intensifiers, charge couple dev materials for mid-wave infrared targeting syst	technologies that enhance laser hardening for sensors, av ospace systems. Develop damage resistant image intensif vices, and architectures for fielded television targeting sys tems and precision-guided munitions.	ionics and components to increase fier tubes. Develop laser damage tems. Evaluate laser hardening					
(U)	\$23,251	Total							
(U) (U)	<u>FY 2003 (\$ in T</u>) \$6,148	<u>nousands</u>) Develop and demonstrate advanced materials aircrews to perform required missions in a las factors evaluation and design refinement. Tra Systems Program Office. Fabricate refined tr filter technology to the PNVG program for fli evaluate hardening technologies for use in pro-	technologies that enhance laser protection for Air Force a er threat environment. Transition flexible filter technolog ansition first generation tristimulus filter technology for da istimulus filter eyewear based on results from human fact ight tests. Continue the development of tunable filter tech ptecting eyes from agile laser threats.	aircrews to ensure safety and to enable gy in the form of spectacles for human aytime missions to the Life Support fors study. Transition fixed wavelength mology for PNVGs. Identify and					
(U)	\$6,211	Develop and demonstrate advanced materials survivability and mission effectiveness of area hardening solutions for Charge Coupled Devi	technologies that enhance laser hardening for sensors, av ospace systems. Demonstrate complete hardening for a fi ce imaging systems. Initiate hardening development for 1	ionics, and components to increase elded TV sensor system. Develop multispectral and hyperspectral sensor					
Р	Project 2100		Page 4 of 15 Pages	Exhibit R-2A (PE 0603112F)					
			254						
	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 2002							
--	---	---	------------------------------						
BUD0 03 -	GET ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for We	PROJECT apon Systems 2100						
(U) (U) (U)	A. Mission Description Continued FY 2003 (\$ in Thousands) Continued systems. \$12,359 Total								
(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	 B. Project Change Summary Not Applicable. C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602102F, Materials. PE 0602202F, Human Effectiveness Applied Research. PE 0603231F, Crew Systems and Personnel Protection Technology. PE 0603500F, Multi-disciplinary Adv Dev Space Technology PE 0604706F, Life Support System Coordinated through the Tri-Service Laser Hardening Materials and Structure This project has been coordinated through the Reliance process to harmonize 	es Working Group and the Joint Service Agile Laser Ey efforts and eliminate duplication.	ve Protection Program.						
(U) (U) (U)	 D. Acquisition Strategy Not Applicable. E. Schedule Profile Not Applicable. 								
F	Project 2100 Page	5 of 15 Pages	Exhibit R-2A (PE 0603112F)						

	RDT&E	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDO 03 -	BET ACTIVITY Advanced Tech	nology Development			PE NUMBE	r and title 2F Adva	nced Ma	terials fo	r Weapo	n System	PROJECT IS 3153
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3153	Non-Destructive Ins	spection Development	10,099	6,692	3,488	3,819	4,153	4,233	4,313	Continuing	TBD
(U)	A. Mission Description Develops and demonstrates advanced Non-Destructive Inspection/Evaluation (NDI/E) technologies to monitor performance integrity and to detect failure causing conditions in weapon systems components and materials. NDI/E capabilities greatly influence and/or limit many designs, manufacturing, and maintenance practices. Reduction in the number of fighter wings and the need for rapid sortie generation demand an ability to perform real-time NDI/E more rapidly than current capability. This project provides technology to satisfy Air Force requirements to extend lifetimes of current systems through increased reliability and cost-effectiveness at field and depot maintenance levels. Equally important is assuring manufacturing quality, integrity, and safety requirements. Note: In FY 2002, Congress added \$2.1 million for technology development investment for aging aircraft and \$1.0 million for handheld holographic radar gun which explains the perceived decrease in FY 2003.										
(U) (U)	 <u>FY 2001 (\$ in Thousands</u>) \$6,912 Developed and demonstrated advanced technologies for improved capabilities in materials corrosion and fatigue monitoring and testing of aging aircraft to reduce operation and maintenance costs and to guarantee full operability and safety of the aircraft fleet. Transitioned to industry enhanced laser-generated ultrasonics for corrosion detection that use an alternate source of laser pulses to generate ultrasound and are efficiently transmitted through fiber optics. This enables laser-based ultrasonics sensors for remote access inspection. Transitioned a high-resolution digital radioscopy technique to evaluate and characterize cracks as an alternative to current X-ray film-based systems. This technique oliminates the need for hyperday material wave and arehies alternative to current X-ray film-based systems. This 										
(U)	\$1,731	731 Developed and demonstrated advanced inspection technologies supporting low-observable (LO) systems to enhance affordability and ensure full performance and survivability. Transition a LO material assessment tool for fighter aircraft. Develop an advanced multispectral LO nondestructive evaluation (NDE) tool for assessing radio frequency signature (zone versus whole aircraft) that is real-time, small, lightweight, portable, user friendly, and covers multiple frequency bands. Evaluate an advanced hand-held directional reflectometer for field level infrared advanced band-held directional reflectometer for field level infrared advanced									
(U)	\$558	Developed and demonstrated to extend the total `safe' life o engine rotary components for and enable enhanced analysis	advanced te of turbine en planned life of the aging	chnologies f gine disks. I e extension o g aircraft flee	for improved Evaluated NI of engine roto et.	capabilities DE benchma ors. Develop	to assess high orks and devo ord a method	gh cycle fati elop an auto l to retain di	gue and eng mated inspec gital NDE re	ine life predi ction capabil ecords for ex	ction practices ity to inspect tended periods
Р	roject 3153			Page	6 of 15 Page	es			Ex	hibit R-2A (PE 0603112F)

	RDT&	DATE February 2002							
BUD0 03 -	GET ACTIVITY - Advanced Tec	hnology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for We	PROJECT PROJECT 3153					
(U)	A. Mission Descrip	tion Continued							
(U) (U)	<u>FY 2001 (\$ in Thou</u> \$898	sands) Continued Developed and demonstrated advanced technolog condition-based maintenance actions on aerospac baseline capability method to detect changes in ke motors.	ies for improved capabilities to monitor vehicle health and e vehicles. Investigate interfaces to material behavior pred ey material properties necessary for ten-year service life est	enable anticipatory iction tools. Established a NDE imate prediction of solid rocket					
(U)	\$10,099	Total							
(U) (U)	FY 2002 (\$ in Thousands) \$3,270 Develop and demonstrate advanced technologies for improved capabilities in materials corrosion, fatigue monitoring, and testing of aging aircraft to reduce operation and maintenance costs. These technologies will guarantee full operability and safety of the aircraft fleet. Develop and demonstrate advanced technologies for improved capabilities in detection and characterization of corrosion in aging aircraft while emphasing improving the probability of detecting serviceable cracks. Develop advanced methods to detect cracks in multiple layers to meet								
(U)	\$1,434	Develop and demonstrate advanced technologies extend the total `safe' life of turbine engines. Tran- automated inspection capability to inspect engine to extend the life of fracture-critical gas turbine en- advanced X-ray robotic brassboard to measure su	for improved capabilities to assess high cycle fatigue and e nsition nondestructive evaluation (NDE) benchmarks and c rotary components for increased rotor life extension. Inve- ngine components and develop techniques for subsurface co rface residual stress on full-scale turbine engine component	ngine life prediction practices to ontinue development of an stigate candidate NDE techniques omponent evaluations. Develop an ts.					
(U)	\$1,988	Develop and demonstrate advanced inspection tec performance and survivability. Demonstrate an a whole aircraft) that is real-time, lightweight and p field an advanced hand-held directional reflectom	chnologies supporting low-observable (LO) systems to enha dvanced multispectral LO NDE tool for assessing radio fre ortable, user friendly, and covers multiple frequency bands eter for field level infrared signature NDE.	ance affordability and ensure full quency signature (zone versus a. Complete and transition to the					
(U)	\$6,692	Total							
(U) (U)	<u>FY 2003 (\$ in Thous</u> \$1,141	sands) Develop and demonstrate advanced technologies aircraft to reduce operation and maintenance costs and demonstrate advanced technologies for impro Develop and demonstrate advanced methods to de	for improved capabilities in materials corrosion, fatigue mo s. These technologies will guarantee full operability and sa oved capabilities in detection and characterization of corros etect cracks in multiple layers to meet aging aircraft life ext	onitoring, and testing of aging fety of the aircraft fleet. Develop ion of joints in aging aircraft. ension requirements.					
Р	Project 3153]	Page 7 of 15 Pages	Exhibit R-2A (PE 0603112F)					
			257						

	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 2002								
BUDO	Get ACTIVITY	PE NUMBER AND TITLE	PROJECT							
03 - (II)	A Mission Description Continued	0005112F Advanced Materials for We	apon systems 5155							
(U) (U) (U)	FY 2003 (\$ in Thousands) Continued \$1,409 Develop and demonstrate advanced technologies for improved capabilities to assess high cycle fatigue and engine life prediction practices to extend the total 'safe' life of turbine engines. Continue transition of NDE benchmarks. Test an automated inspection capability to inspect engine rotary components for planned life extension of engine rotors. Downselect optimal NDE approaches to extend the life of fracture-critical gas turbine engine components and establish protocols for component inspections. Develop residual stress gradient									
(U) (U)	 \$938 \$938 \$938 Develop and demonstrate advanced inspection technologies supporting low-observable systems to enhance affordability and ensure full performance and survivability. Transition to the field an advanced multispectral low-observable nondestructive evaluation tool for assessing radio frequency signature (zone vs. whole aircraft) that is real-time, small, lightweight, portable, user friendly, and covers multiple frequency bands. \$3.488 									
(U)	B. Project Change Summary									
(U) (U) (U) (U) (U)	Not Applicable. <u>C. Other Program Funding Summary (\$ in Thousands)</u> Related Activities: PE 0602102F, Materials. This project has been coordinated through the Reliance process to harmonize <u>D. Acquisition Strategy</u> Not Applicable	efforts and eliminate duplication.								
(U) (U)	Not Applicable. <u>E. Schedule Profile</u> Not Applicable.									
Р	roject 3153 Page	e 8 of 15 Pages	Exhibit R-2A (PE 0603112F)							

	RDT&I	E BUDGET ITEM JU	STIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
виро 03 -	GET ACTIVITY • Advanced Tech	nnology Development			PE NUMBE	R AND TITLE 2F Adva	nced Ma	terials fo	r Weapo	n System	PROJECT IS 3946
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3946	Materials Transition	n	21,694	14,458	3,173	5,256	5,582	5,746	4,779	Continuing	TBD
Note 3946 (U)	: In FY 2002, the deployment is the transferred to A. Mission Descript	loyed air base demonstration ef PE 0603500F, Project 5032, in <u>ion</u>	forts in Proje conjunction	ect 3946, are with the Spa	transferred ace Commiss	within this P sion recomm	PE into Proje nendation to	ct 4918. In consolidate	FY 2003, sp all space uni	ace unique ta que activitie	asks in Project s.
	Develops and demonstrates advanced material and processing technologies for fielded and planned Air Force weapon, airframe, and engine applications. Advanced materials and processes that have matured beyond applied research are characterized, critical data are collected, and critical evaluations in the proposed operating environment are performed. This design and scale-up data enhances overall affordability of promising material and processing technologies, providing needed initial incentive for their industrial development. Note: In FY 2002, Congress added \$1.1 million for Metals Affordability Initiative, \$3.4 million for advanced aluminum aerostructures, \$2.8 million for ceramic matrix composites for engines, \$2.1 million for plasma enhanced chemical deposition techniques, and \$1.0 million for vapor growth carbon fiber which explains the perceived decrease in FY 2003.										
(U) (U)	FY 2001 (\$ in Thous \$12,896	 2001 (\$ in Thousands) By Book (\$ in Thousand									
(U)	\$4,003	and assembly costs. Validated advanced non-linear optical materials for aircraft infrared countermeasures against far-infrared laser sources. Developed and demonstrated advanced materials technologies for space vehicles and subsystems to provide enhanced surveillance and sensing capabilities and improved access to space. Develop improved material processes with increased yields for robust, high performance, and producible infrared focal plane array materials. Demonstrate materials and materials processing technologies to improve spacecraft component designs, performance, and reliability. Evaluate effort to develop the key data needed for reduced risk and increased confidence in organic materials.									
(U)	\$1,751	Developed and demonstrated operations and maintenance of effects test to determine in-se window material with high op the fatigue life management of	advanced m osts and ens rvice perform otical quality of turbine en	aterials tech uring full op mance degra y, durability, gine disks.	nologies to e perability and dation of air and strength	enhance the s d safety of sy craft coating n. Transition	sustainability ystems and p g systems. F ned the utiliz	y of Air Ford personnel. V abricated a l ation of qua	ce areospace falidated an a arge apertur ntitative resi	systems by accelerated e e Aluminum dual stress n	lowering nvironmental Oxynitride neasurements in
Р	roject 3946			Page	9 of 15 Pag	es			Ex	hibit R-2A	(PE 0603112F)
					259						

	RDT&	DATE February 2002								
BUDO 03 -	GET ACTIVITY • Advanced Tec	hnology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for We	PROJECT PROJECT 3946						
(U)	A. Mission Descrip	tion Continued								
(U) (U)	FY 2001 (\$ in Thousands) Continued \$442 Provided affordability education and training through the application of integrated product and process development tenets and cost modeling to the Air Force Science and Technology (S&T) environment. Training is focused on Air Force S&T scientists and engineers, including executives, middle managers, and all advanced development program managers. Initiated education and training of organic IPPD and cost modeling experts in each Air Force S&T Technical Directorate.									
(U)	\$2,602	 \$2,602 Developed technologies (i.e., utilities and shelters) that improve airmobile systems performance and reduce airlift requirements in support of Air Expeditionary Force (AEF) operations. Emphasized two areas of the AEF operations: deployed base systems and physical force protection. Developed scaled air-inflatable frames for large shelters. Demonstrated advanced cycle technologies for mobile heat pumps that reduce weight and volume by 30%. Fabricated a small-footprint fuel cell reformer capable of converting logistics fuels into hydrogen for fuel cell power generation. Fabricated structural retrofits and develop deployable blast protection reinforcement systems for buildings to reduce blast debris hazards. 								
(\mathbf{U})	\$21,094 EV 2002 (\$ in They	Total								
(U) (U)	\$8,566	Develop and demonstrate advanced materials as low-observable performance, and overall afford aircraft with reduced part count and assembly c capacity, increased life, and better environment countermeasure against far-infrared laser source	nd processing technologies for air vehicles and subsystems to ability of air vehicles. Fabricate and characterize integrated o osts. Complete demonstration of advanced aircraft brake mat al stability. Characterize advanced non-linear optical materia	enhance the lift, propulsion, composite structure assemblies for terials with improved braking ls for aircraft infrared						
(U)	 \$1,557 \$1,557 Develop and demonstrate advanced materials and processing technologies for space vehicles and subsystems to provide enhanced surveillance capabilities, improved access to space, and improve the overall affordability of space vehicles. Characterize improved material processes with increased yields for robust, high performance, and producible infrared detector materials. Continue efforts to validate and demonstrate materials and materials processing technologies to improve performance, reliability, and affordability of spacecraft components and 									
(U)	\$4,335	Develop and demonstrate advanced materials at lowering operations and maintenance costs whi of a large-aperture Aluminum Oxynitride windo corrosion abatement treatments and transition th	nd processing technologies to enhance the sustainability of A le ensuring full operability and safety of systems and personn ow material with high optical quality, durability, and strength he results.	ir Force aerospace systems by el. Complete the characterization . Evaluate the effectiveness of						
Р	roject 3946		Page 10 of 15 Pages	Exhibit R-2A (PE 0603112F)						

	RDT	DATE February 2002								
BUD 03	GET ACTIVITY - Advanced Te	echnology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for We	PROJECT eapon Systems 3946						
(U)	A. Mission Desci	ription Continued								
(U) (U)	FY 2002 (\$ in Thousands) Continued\$14,458Total									
(U) (U)	 <u>FY 2003 (\$ in Thousands</u>) \$2,360 Develop and demonstrate advanced materials and processing technologies for air vehicles and subsystems to enhance the lift, propulsion, low-observable performance, and overall affordability of air vehicles. Continue to fabricate and characterize integrated composite structure assemblies for aircraft with reduced part count and assembly costs. Complete the demonstration of advanced non-linear optical materials for aircraft infrared countermeasure against far-infrared laser sources and transition results. Conduct characterization of materials and processes for enhancing the reliability and maintainability of low-observable systems. 									
(U) (U)	 \$813 Bevelop and demonstrate advanced materials and processing technologies to enhance the sustainability of Air Force aerospace systems by lowering operations and maintenance costs and ensuring full operability and safety of systems and personnel. Initiate efforts to develop and characterize corrosion resistant coatings and corrosion prevention compounds for aging aircraft structures applications. \$3 173 									
(U)	<u>B. Project Chang</u> Not Applicable.	ge Summary								
(U) (U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Related Activities PE 0602102F, Ma PE 0603211F, Ae PE 0603202F, Ae PE 0603203F, Ad PE 0603203F, Mu PE 0603216F, Ae This project has b	m Funding Summary (\$ in Thousands) : tterials. rospace Structures rospace Propulsion Subsystem Integration vanced Aerospace Sensors. Ilti-disciplinary Adv Dev Space Technology. rospace Propulsion and Power Technology. een coordinated through the Reliance process to h	narmonize efforts and eliminate duplication.							
(U)	<u>D. Acquisition St</u> Not Applicable.	<u>rategy</u>								
(U) F	E. Schedule Profi Project 3946	ile	Page 11 of 15 Pages	Exhibit R-2A (PE 0603112F)						

GET ACTIVITY PE NUMBER AND TITLE PROJECT - Advanced Technology Development 0603112F Advanced Materials for Weapon Systems 3946 E. Schedule Profile Continued Not Applicable.
- Advanced Technology Development 0603112F Advanced Materials for Weapon Systems 3946 E. Schedule Profile Continued Not Applicable.
E. Schedule Profile Continued Not Applicable.
Not Applicable.
Project 3946 Page 12 of 15 Pages Exhibit R-2A (PE 0603112F)
262

	RDT&E	E BUDGET ITEM JU	STIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
вирс 03 -	BET ACTIVITY Advanced Tech	nology Development			PE NUMBE 060311	r and title 2F Adva	nced Ma	terials fo	r Weapo	n System	PROJECT
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4918	Deployed Air Base	Demonstrations	0	1,400	2,118	1,938	2,415	2,461	2,507	Continuing	TBD
Note (U)	 In FY 2002, the deployed air base demonstration efforts in PE 0603205F, Project 4398, and PE 0603112F, Project 3946, are transferred into this PE in Project 4918. A. Mission Description Supports the Air Expeditionary Forces (AEF) through technology development and demonstration of advanced rapid deployment airbase technologies that reduce airlift, setup times, manpower requirements, and sustainment costs. Develops and demonstrates efficient and cost-effective technologies to provide physical protection technologies including fire fighting, to AEF deployed warfighters and infrastructure. Develops and demonstrates affordable, rapid deployment technologies that ensure military readiness, support advanced weapon systems, and enable enhanced peacetime training operations. 										
(U) (U) (U)	<u>FY 2001 (\$ in Thousa</u> \$0 \$0	2001 (\$ in Thousands) This effort was performed in PE 0603205F, Flight Vehicle Technology, Project 4398, Air Base Technology, (\$7.794 million) and PE 0603112F, Advanced Materials for Weapon Systems, Project 3946, Materials Transition, (\$2.770 million). Total									
(U) (U)	<u>FY 2002 (\$ in Thousa</u> \$550	 FY 2002 (\$ in Thousands) \$550 Demonstrate and transition advanced rapid deployment airbase technologies that reduce airlift, setup times, manpower requirements, and sustainment costs in support of AEF technologies. Develop deployable shelters/heat pump, power, and rapid airfield assessment technologies that improve air mobile systems performance and reduce airlift requirements in support of AEF. Develop advanced aircraft fire fighting agents and equipment. Demonstrate highly effective, deployable crash/rescue technologies based on three-dimensional foam technology to support 									
(U)	\$108	Demonstrate and transition affordable, rapid deployment technologies that ensure military readiness, maintain aerospace missions, support advanced weapon systems, and enable peacetime training operations. Develop advanced waste reactor technologies to support deployed waste management systems. Develop full-scale design and fabricate rapidly deployable mixed-base hydrogen peroxide production plant for airborne laser operations									
(U)	\$742	Demonstrate and transition ef and infraststructure. Develop autonomous ground vehicles	ficient and c deployable to support A	ost-effective protective a ir Force ope	e technologie nd reactive b trational requ	es to provide plast suppres prements for	e physical pr sion technol r unexplodeo	otection tech ogies to prot l ordnance c	nologies to tect deployed learance and	AEF deploye d warfighters l active range	ed warfighters b. Develop e operations.
Р	roject 4918			Page	13 of 15 Pag	ges			Ex	hibit R-2A ((PE 0603112F)

	RDT&	February 2002								
BUDGE 03 - /	et activity Advanced Tec	hnology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for V	PROJECT Veapon Systems 4918						
(U)	A. Mission Descrip	tion Continued								
(U) (U)	FY 2002 (\$ in Thousands) Continued\$1,400Total									
(U) (U)	FY 2003 (\$ in Thousands)\$1,147Demonstrate and transition advanced rapid deployment airbase technologies that reduce airlift, setup times, manpower requirements, and sustainment costs in support of Air Expeditionary Forces (AEF) technologies. Continue development of shelters, power, and rapid airfield assessment technologies that improve air mobile systems performance and reduce airlift requirements in support of AEF operations. Develop advanced aircraft fire fighting technologies such as fire fighting agents and equipment. Transition highly effective, deployable crash/rescue system based on three-dimensional foam technology to support AEF operations.									
(U)	\$125 Demonstrate and transition affordable, rapid deployment technologies that ensure military readiness, maintain aerospace missions, support advanced weapon systems, and enable peacetime training operations. Continue development of advanced waste reactor technologies to support emerging weapons. Demonstrate rapidly deployable full-scale mixed-base hydrogen peroxide production plant that reduces the airborne laser logistics burdens by thirty percent.									
(U)	\$846	Demonstrate and transition efficient and cost- and infrastructure. Develop deployable protect Continue development of autonomous vehicle range operations.	effective technologies to provide physical protection technol tive and reactive blast suppression technologies to protect d s to support Air Force operational requirements for unexplo	ogies to AEF deployed warfighters eployed warfighters. ded ordnance clearance and active						
(U)	\$2,118	Total								
(U)	B. Project Change Not Applicable.	Summary								
(U)	 U) <u>C. Other Program Funding Summary (\$ in Thousands)</u> U) Related Activities: U) PE 0602102F, Materials U) This project has been coordinated through the Reliance process to harmionize efforts and eliminate duplication 									
(U) <u>I</u> N	D. Acquisition Stra Not Applicable.	tegy								
(U) <u>I</u>	<u>E. Schedule Profile</u>									
Pro	oject 4918		Page 14 of 15 Pages	Exhibit R-2A (PE 0603112F)						

	RDT&E BUDGET ITEM JUSTIFIC	DATE Februarv	2002						
BUDG	GET ACTIVITY	PE NUMBER AND TITLE		PROJECT					
03 -	Advanced Technology Development	0603112F Advanced Materials for W	eapon Systems	4918					
(U)	E. Schedule Profile Continued								
(U)	Not Applicable.								
Р	roject 4918	Page 15 of 15 Pages	Exhibit R-2A (PE	0603112F)					
		265							
	UNCLASSIFIED								

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM J	USTIFIC	ATION	SHEET	(R-2 Ex	(hibit)		DATI	Februa	ary 2002
BUDGET ACTIVITY 03 - Advanced Technology Development				PE NUMBER AND TITLE PRO. 0603202F Aerospace Propulsion Subsystems 668 Integration 668					
COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
668A Aircraft Propulsion Subsystem Integration	33,267	0	0	0	0	0	C	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	C	0	0
 Note: In FY 2002, efforts transferred to PE 0603216F, Pro (U) <u>A. Mission Description</u> This project develops and demonstrates gas turbine p (APSI) project includes demonstrator engines such a Concept for unmanned air vehicle and cruise missile under the Advanced Turbine Engine Gas Generator 	pipect 4921, in propulsion t as the Joint T e application:	n order to ali echnologies 'echnology I s. The APS	gn projects v applicable to Demonstrato I demonstra	with the Air o a broad ran r Engine for tor engines in technology	Force Resea	ft. The Airc tems and the core (high-p	ory organiz craft Propul Joint Expe pressure spo	ation. sion Subsyste indable Turbi pol) technolog	em Integration ne Engine gy developed

under the Advanced Turbine Engine Gas Generator with the engine (low-pressure spool) technology such as fans, turbines, engine controls, and exhaust nozzles. This project also focuses on integration aspects of inlets, nozzles, engine/airframe compatibility, and low-observable technologies. APSI will provide enabling technology for increasing aircraft range and cruise speed 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. The APSI project supports the goals of the Integrated High Performance Turbine Engine Technology (IHPTET) program, which is focused on doubling 1987 turbine engine propulsion capabilities by 2005 while reducing cost of ownership. The IHPTET program provides continuous technology transition for military turbine engine upgrades and derivatives, and has the added dual-use benefit of enhancing the United States turbine engine industry's international competitiveness. Technology innovations developed in this project are applicable to current and future Air Force turbine engines.

(U) <u>FY 2001 (\$ in Thousands</u>)

- (U) \$5,103 Designed, fabricated, and demonstrated durability and integration technologies for turbofan/turbojet engines for improved supportability and affordability of current and future Air Force aircraft. Completed engine testing in support of the national High Cycle Fatigue (HCF) program, including fan blade damage tolerance, frangible bearings, prognostics and health management, and turbine engine explosive blade out concept demonstration.
- (U)\$21,246Designed, fabricated, and tested advanced component technologies for improved performance and fuel consumption of turbofan/turbojet
engines for fighters, bombers, and transports. Fabricated a full-demonstrator engine test fixed inlet guide vanes and moderate aspect ratio rotor,
Integrally Bladed Rotor repair, fan rim damper, HCF mistuning technologies, vaneless counterrotating high/low pressure turbine, probabilistic

Project 668A	Page 1 of 3 Pages	Exhibit R-2 (PE 0603202F)
	267	

	RDT&	DATE February 2002		
BUD(03 -	GET ACTIVITY Advanced Tech	nology Development	PE NUMBER AND TITLE 0603202F Aerospace Propulsion Sub Integration	PROJECT 668A
(U)	A. Mission Descripti	on Continued		
(U)	FY 2001 (\$ in Thouse	nds) Continued rotor system design, gamma titanium aluminide low pr technologies. Continued advanced engine designs for turbine (LPT) blade, uncooled Ceramic Matrix Compo technologies are applicable to a significant part of the	essure turbine coverplate, sprayform cast hardware, ar High Cycle Fatigue robust front frame, two-stage forw site (CMC) LPT blade, and model-based control with current Air Force inventory as well as future turbine er	nd Ceramic Matrix Composite vard swept fan, tiled low pressure diagnostics. All of these ngines.
(U)	\$4,512	Designed, fabricated, and tested advanced component to missile and uninhabited air vehicle applications. Conti ceramic high/low pressure turbine, and slinger combus	technologies for improved performance, durability, and nued design of organic matrix composite fan, high sta tor.	d affordability of engines for ge loading splittered fan, uncooled
(U)	\$1,926	Designed and initiated fabrication of integrated propuls propulsion concepts in support of Defense Advanced R	sion designs to demonstrate performance and durabilit Research Projects Agency missile demonstration.	y of advanced hypersonic
(U)	\$480	Designed a low volume, high temperature and pressure applications.	e combustor. Evaluated performance in cruise missile	or uninhabited air vehicle
(U)	\$33,267	Total		
(U)	FY 2002 (\$ in Thousa	ands)		
(U) (U)	\$0 \$0	Efforts moved to PE 0603216F, Project 4921. Total		
(U)	FY 2003 (\$ in Thousa	unds)		
(U)	\$0 \$0	No activity.		
(U)	\$0	lotal		
(U)	B. Budget Activity J This program is in Bu system developments	ustification Idget Activity 3, Advanced Technology Development, si that have military utility and address warfighter needs.	nce it develops and demonstrates technologies for exis	sting system upgrades and/or new
Р	roject 668A	Page	2 of 3 Pages	Exhibit R-2 (PE 0603202F)

	RDT&E BUDGET ITEM JUSTIFICA	DATE Februa	ary 2002			
BUD 03	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603202F Aerospace Integration	PE NUMBER AND TITLE 0603202F Aerospace Propulsion Sub Integration			
(U)	C. Program Change Summary (\$ in Thousands)	<u>FY 2001</u>	<u>FY 2002</u>	FY 2003	<u>Total Cos</u>	
(U) (U) (U)	Previous President's Budget Appropriated Value Adjustments to Appropriated Value a. Congressional/General Reductions	34,619 34,940	0 0	0		
	b. Small Business Innovative Researchc. Omnibus or Other Above Threshold Reprogramd. Below Threshold Reprograme. Rescissions	-820 -532 -321				
(U) (U)	Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR Significant Program Changes:	33,267	0	0	TBD	
(U) (U) (U) (U) (U) (U) (U) (U) (U)	Note: In FY 2002, the efforts performed under this program transfe D. Other Program Funding Summary (\$ in Thousands) Related Activities:PE 0602203F, Aerospace Propulsion.PE 0603112F, Advanced Materials for Weapon SystemsPE 0603216F, Aerospace Propulsion and Power Technology.PE 0602122N, Aircraft TechnologyPE 0603217N, Air Systems Advanced Technology Demonstration.This project has been coordinated through the Reliance process to have	armonize efforts and eliminate duplicat	ion.			
(U) (U) (U)	 <u>E. Acquisition Strategy</u> Not Applicable. <u>F. Schedule Profile</u> Not Applicable. 					
F	Project 668A	Page 3 of 3 Pages		Exhibit R-2	(PE 0603202F)	

THIS PAGE INTENTIONALLY LEFT BLANK

	RDT&E BUDGET ITEM J	DATE	February 2002							
BUDGE ⁻ 03 - A	T ACTIVITY			PE NUMBE 060320	R AND TITLE	nced Ae	rospace	Sensors		
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	44,774	60,914	50,589	42,072	37,115	38,011	38,045	Continuing	TBD
5019	Advanced RF Technology for ISR Sensors	0	0	4,725	6,047	4,250	5,925	5,531	Continuing	TBD
665A	Advanced Aerospace Sensors Technology	17,156	17,334	11,241	10,157	10,976	9,922	11,063	Continuing	TBD
69DF	Target Attack and Recognition Technology	27,618	43,580	34,623	25,868	21,889	22,164	21,451	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	Continuing	TBD

In FY 2002, work performed under PE 0603253F, Projects 2735 and 666A, moves to this PE, Project 665A. Apparent project ramp in Project 665A is due only to realignment of the projects. In FY 2003, efforts in advanced radio frequency (RF) technologies for intelligence, surveillance, and reconnaissance (ISR) sensors previously performed in this PE, Project 665A, transfers to this project. Also in FY 2003, space unique tasks in this PE, Project 665A, will be transferred to PE 0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) <u>A. Mission Description</u>

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 (ECCM), 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 2002, Congress added \$1.0 million for Advanced Physical Vapor Transport and \$7.4 million for the Radar Target Modeling Thrust.

(U) <u>B. Budget Activity Justification</u>

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.

Page 1 of 13 Pages	Exhibit R-2 (PE 0603203F)
271 UNCLASSIFIED	

	RDT&E BUDGET ITEM JUSTIFIC	DATE Febru	DATE February 2002		
BUD	GET ACTIVITY	PE NUMBER AND TITLE			
0 3 ·	Advanced Technology Development	0603203F Advance	d Aerospace	Sensors	
(U)	C. Program Change Summary (\$ in Thousands)				
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	Total Cos
(U)	Previous President's Budget	46,381	55,809	43,098	
(U)	Appropriated Value	46,811	61,509		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions		-595		
	b. Small Business Innovative Research	-1,100			
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram	-507			
	e. Rescissions	-430			
(U)	Adjustments to Budget Years Since FY 2002 PBR			7,491	
(U)	Current Budget Submit/FY 2003 PBR	44,774	60,914	50,589	TBD
(U)	Significant Program Changes:				

In FY 2002, work performed under PE 0603253F, Projects 2735 and 666A, moves to this PE, Project 665A. Apparent project ramp in Project 665A is due only to realignment of the projects. In FY 2003, space unique tasks in this PE, Project 665A, will be transferred to PE 0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

Page 2 of 13 Pages

Exhibit R-2 (PE 0603203F)

	RDT&E	E BUDGET ITEM JU	STIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDO 03 -	BUDGET ACTIVITY PE NUMBER AND TITLE 03 - Advanced Technology Development 0603203F Advanced Aerospace Sensors										PROJECT 5019
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5019	Advanced RF Tech	nology for ISR Sensors	0	0	4,725	6,047	4,250	5,925	5,531	Continuing	TBD
In FY trans	7 2003, efforts in advar fers to this project.	nced radio frequency technolog	ies for intell	igence, surv	eillance, and	l reconnaissa	ince (ISR) se	ensors previo	ously perform	med in this P	E, Project 665A,
(U)	A. Mission Descripti This project develops clutter and jamming e cross section) and gro radiation hardened) se	ion and demonstrates radio freque environments. This project pro bund-based high value, time-cri ensor capabilities (including int	ncy (RF) aen vides the wa tical targets. regrated elec	rospace surv rfighter with Work inclu tro-optical n	eillance sens a sensors cap ades develop nixed signal)	ors and sign able of deter ing aerospac , as well as	al processin cting and tra e environme advanced co	g for ISR sen cking both a entally qualit mponent and	nsors capabl irborne (cor fied (vibrational) l subsystem	le of operatin iventional an on, shock, ter technologies	g in adverse d low radar mperature, and S.
(U) (U) (U)	<u>FY 2001 (\$ in Thouse</u> \$0 \$0	ands) No Activity Total									
(U) (U) (U)	<u>FY 2002 (\$ in Thouse</u> \$0 \$0	ands) No Activity Total									
(U) (U)	FY 2003 (\$ in Thousa \$882	ands) Configure data collection opp ground moving target indicati manned test aircraft to demor	ortunities us on (GMTI), strate multi-	sing existing and foliage	assets for va penetrating surveillance	alidation of t ground targe	echniques g t indication.	enerated for Initiate effo	advanced ai ort to design	r moving tar a flexible te	get indication, stbed using a
(U)	\$1,503	Conduct in-house development of a multi-intelligence sensor design, utilizing technologies developed in aperture development, signal processing, and radar design. Develop techniques for discriminating ground from air targets under conditions of common pulse repetition fragmenties.									
(U)	\$1,457	Develop advanced radar signa difficult targets in hostile env control performance in GMT	al processing ironments. sensors. In	g techniques Develop kno nplement mu	to mitigate o wledge-aide ılti-dimensio	clutter and ja d radar sign nal adaptive	mming inter al processing processing	ference, and g techniques techniques a	improve de for improve nd knowled	etection and t ed detection a ge-aided rad	racking of and false alarm ar signal
Р	roject 5019			Page	3 of 13 Pag	es			Ex	chibit R-2A	(PE 0603203F)

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) DATE February 2002									
BUD 03	GET ACTIVITY • Advanced Technology Development	PROJECT sors 5019								
(U)	A. Mission Description Continued									
(U)	FY 2003 (\$ in Thousands) Continued processing techniques on selected advanced compo- applications	uting architectures, and demonstrate these techniques for r	nulti-mission aerospace radar							
(U)	 applications. bevelop and demonstrate photonic digital and analog mixed signal multi-gigahertz component architectures. Develop and integrate chip-scale photonic and hybrid mixed signal components for radio frequency signal generation, phased array antenna beam formation, and beam control. Develop and demonstrate high-resolution wide bandwidth photonic wavelength division multiplexing and signal processing technology. Provide performance modeling, verification, and analysis of photonic and hybrid mixed signal devices for military unique applications. 									
(U)	\$4,725 Total									
(U)	<u>B. Project Change Summary</u> Not Applicable.									
(U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602204F, Aerospace Sensors. PE 0603270F, Electronic Combat Technology. PE 0603500F, Multi-disciplinary Adv Space Tech. PE 0604270F, Electronic Warfare (EW) Development. This project has been coordinated through the Reliance process to harmor	nize efforts and eliminate duplication.								
(U)	D. Acquisition Strategy Not Applicable.									
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.									
F	roject 5019 P	Page 4 of 13 Pages	Exhibit R-2A (PE 0603203F)							

	RDT&	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	nry 2002
BUDGET ACTIVITY PE NUMBER AND TITLE 03 - Advanced Technology Development 0603203F Advanced Aerospace Sensors											PROJECT 665A
	COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
665A	Advanced Aerospa	ace Sensors Technology	17,156	17,334	11,241	10,157	10,976	9,922	11,063	Continuing	TBD
In F space perfo	Y 2003, space unique e unique activities. Al prmed in this project w	tasks in this project will be trans lso in FY 2003, efforts in advanc vill transfer to this PE, Project 50	ferred to PE ced radio fre)19.	0603500F, quency tech	Project 5034 nologies for	, in conjunc intelligence	tion with the	e Space Com e, and recom	mission reconnaissance (IS	ommedation SR) sensors	to consolidate all previously
(U)	A. Mission Descrip This project develop attack radar sensors, target both airborne radar and electronic	tion os and demonstrates aerospace se , and electronic counter-countern (conventional and low radar cro combat technology. Desired wa	ensor techno neasures (EC ss section) a urfighting ca	logies for ma CCM) for rad nd ground-b pabilities ind	anned and ur dars. It prov ased, high-v clude the abi	nmanned pla ides aerospa alue, time-cr lity to detect	tforms, incluce platforms ritical targets concealed t	uding electro with the ca s. Project ac argets in dif	o-optical (EC pability to p tivities inclu ficult backgr)) sensors, ta recisely dete ide developi round condit	rgeting and ct, track, and ng multi-function ions.
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$641	sands) Developed integrated EO sen achievable, whether the targe performed utility assessments	sor technolo ts are camou	gy to search iflaged, low-	, detect, loca observable, ated targetin	ite, and ident or employin	tify air and g g other mea	round target	ts at ranges l on. Optimiz	onger than c zed sensor de	urrently esign and
(U)	\$10,500	Developed EO sensor technol signature data collection expe imaging sensor for high altitu	logies to determents to d de reconnais	ect and locat etermine per	e camouflag rformance pa	ed and conc	ealed targets r day/night h	for aerospa	ce ISR appli l sensors. Fa	cations. Co abricated a h	ompleted critical yperspectral
(U)	\$868	Developed advanced radar sig	gnal process	ing techniqu	es to mitigat	e clutter and	l jamming in	terference a	nd improve	detection and	l tracking of
(U)	\$3,148	difficult targets. Demonstrated ability to detect slow moving airborne and ground targets from an airborne platform. Developed and demonstrated the radio frequency (RF) sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deceptive techniques. Performed flight test demonstrations of foliage penetration RE sensor and real time image formation algorithms.									
(U)	\$20	Developed technology to low	er life cycle	costs of rad	ar systems.	Developed lo	ow-cost, ligł	ntweight ante	ennas using	micro-electro	o-mechanical
(U)	\$765	Developed advanced EO sens modifications prior to sensor	transition.	gy for non-co	coperative ta	urget identifi	cation. Flig	ht tested eye	-safe sensor	. Performed	necessary
Р	roject 665A			Page	5 of 13 Pag	es			Ex	hibit R-2A	(PE 0603203F)

	RDT	DATE February 2002		
вирс 03 -	GET ACTIVITY - Advanced Te	echnology Development	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sens	PROJECT SORS 665A
(U)	A. Mission Desc	ription Continued		
(U)	<u>FY 2001 (\$ in Th</u>	nousands) Continued		
(U)	\$133	Developed advanced multi-function sens Demonstrated and evaluated affordable, transmit/receive modules on manned and	or component technologies for radar, electronic warfare, navigation high performance radio frequency (RF) circuits and packaging technologies and packaging technologies (In FY 2000, this work was performed in this	, and communications applications. nologies for use in phased array is PE, Project 69CK.)
(U)	\$743	Developed advanced RF photonic signal photonic beamforming. Designed and fa	control and distribution technologies for phased array apertures. D bricated true-time-delay photonic technology for phased array anter pplications. (In EV 2000, this effort was conducted under PE 0603)	emonstrated and evaluated mas used in intelligence, 726F. Project 2863.)
(U)	\$338	Developed and demonstrated advanced in surveillance, and reconnaissance (ISR) a radar operations.	nodular, shareable digital RF sensor technologies for aerospace sense pplications. Fabricated and tested dual-use, modular digital RF rece	sor suites used in intelligence, eiver components for multi-mode
(U)	\$17,156	Total		
(U)	<u>FY 2002 (\$ in Th</u>	nousands)		
(U)	\$2,710	Develop integrated electro-optical (EO) s longer than currently achievable, includin begin demonstrating active and passive s	sensor technology to search, detect, locate, and identify air and ground targets that are camouflaged, low-observable, or employ other mensor components of an affordable, integrated targeting capability.	nd targets at ranges significantly eans of deception. Design and
(U)	\$3,718	Develop EO sensor technologies to detec demonstration sensor for high altitude re-	et and locate camouflaged and concealed targets for aerospace ISR a connaissance aircraft, perform initial system utility demonstrations,	pplications. Continue fabricating a and develop signature-based data
(U)	\$1,032	Develop advanced radar signal processin difficult targets. Design processing architechniques for multi-mission aerospace r	g techniques to mitigate clutter and jamming interference and impro tecture for evaluating multi-dimensional adaptive processing techni adar applications.	ove detection and tracking of iques. Demonstrate these
(U)	\$3,231	Develop, test, evaluate, and demonstrate concealed through staelth or deceptive te concept design study for a 'mini' unmann difficult to detect through either stealth o	the RF sensor techniques required to detect, track, and target high-v chniques. Demonstrate technologies to increase detection range for ed aerospace vehicle RF sensor to detect, track, and target high-value r concealment.	value, time-critical targets that are · low-observable targets. Initiate ue, time-critical targets that are
(U)	\$908	Develop advanced EO sensor technology multi-function laser for air and ground ta	for non-cooperative target identification. Complete design and begrget identification.	zin development of a
Р	Project 665A		Page 6 of 13 Pages	Exhibit R-2A (PE 0603203F)

	RD	DATE February 2002		
BUDG 03 -	BET ACTIVITY Advanced T	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sens	PROJECT	
(U)	A. Mission Des	cription Continued		
(U) (U)	<u>FY 2002 (\$ in T</u> \$1,099	housands) Continued Develop advanced multi-function sensor Initiate evaluation of very high density ty manned and unmanned platforms. Com Develop advanced radio frequency (RF)	component technologies for radar, electronic warfare, navigation, a wo-dimensional and three-dimensional interconnects for phased arra plete testing a multi-chip module version of a monobit receiver for e photonic signal control and distribution technologies for phased arra	nd communications applications. y transmit/receive modules on electronic warfare applications. ay apertures.
(U)	\$1,985	Develop and demonstrate advanced mod surveillance, and reconnaissance (ISR) a and jammer cancellation. (In FY 2001, t	ular, sharable, digital RF sensor technologies for aerospace sensor supplications. Demonstrate a multi-channel radar digital receiver with his work was performed in PE 0603253F, Project 2735.)	uites performing intelligence, a channel match greater than 60dB
(U)	\$1,660	Develop technologies to maximize Globa improve offensive and defensive combat location technology supporting multi-ser 666A.)	al Positioning System (GPS) jam resistance, positional accuracy, and capabilities. Design advanced GPS M-Code technology. Develop asor and distributed sensor integration. (In FY 2001, this work was p	l exploitation techniques to geo-registration and precise target performed in PE 0603253F, Project
(U)	\$991	Develop deposition techniques for high g transport techniques.	growth rate, high quality silicon carbide semiconductor substrates to	enable advanced physical vapor
(U)	\$17,334	Total		
(U)	<u>FY 2003 (\$ in T</u>	housands)		
(U)	\$3,239	Develop integrated electro-optical (EO) s longer than currently achievable, includi fabricating and testing a ground demonst	sensor technology to search, detect, locate, and identify air and grounng targets that are camouflaged, low-observable, or employ other metation sensor and aircraft integration design. Assess real-time data	nd targets at ranges significantly eans of deception. Complete processing performance.
(U)	\$3,333	Develop EO sensor technologies to detect and testing a demonstration sensor for his processing performance	et and locate camouflaged and concealed targets for aerospace ISR a gh altitude reconnaissance aircraft. Perform flight characterization.	pplications. Complete fabricating Assess signature-based data
(U)	\$1,398	Develop advanced EO sensor technology multi-function laser for air and ground ta	v for non-cooperative target identification. Complete design and begrget identification.	gin development of a
(U)	\$1,210	Develop technologies to maximize GPS and defensive combat capabilities. Deve in buildings, underground, and in air and	jam resistance, positional accuracy, timing accuracy, and exploitation lop advanced GPS M-Code technologies. Develop reference technologies space to provide precise time, position, and velocity for multiple pl	in techniques to improve offensive plogies to adaptively operate GPS atforms. Develop virtual flight test
Р	roject 665A		Page 7 of 13 Pages	Exhibit R-2A (PE 0603203F)

	RDT8	E BUDGET ITEM JUSTIFICA	DATE	DATE February 2002		
BUDO 03 -		chnology Development	PE NUMBER AND TITLE 0603203F Advanced Aero	ospace Sensors	PROJECT 665A	
(U)	A. Mission Descri	ption Continued				
(U)	FY 2003 (\$ in Thou	usands) Continued				
(U)	\$1,828	technology for improved assessment of GPS Develop, test, evaluate, and demonstrate the difficult to detect through either stealth or co performance improvements in the detection	S anti-jam technologies. RF sensor techniques required to detect, track, a oncealment. Evaluate 'mini' unmanned aerospace tracking and targeting of high-value time-critic	and target high-value, time-criti e vehicle concept of operation a	ical targets that are and RF sensor	
(U) (U)	\$233 \$11,241	Provide concept definition and system analy Total	vsis of a fire control radar system for airborne ap	plications.		
(U)	<u>B. Project Change</u> Not Applicable.	Summary				
	C. Other Program Related Activities: PE 0602204F, Aero PE 0603205F, Fligh PE 0603707F, Wea PE 0603500F, Mult PE 0602111N, Wea PE 0602232N, Spac PE 0604249F, LAN PE 0603270F, Elect An MOA has been including deception This project has been	espace Sensors. At Vehicle Technology. ther Systems Advanced Development. i-disciplinary Adv Space Tech. apons Technology. the and Electronic Warfare (SEW) Technology. (TIRN Night Precision Attack. tronic Combat Technology. established between AFRL and DARPA to joint , camouflage, concealment, and deep hide. en coordinated through the Reliance process to h	tly develop the technology required to detect high narmonize efforts and eliminate duplication.	h-value, time-critical targets in	a variety of environme	
(U)	D. Acquisition Stra Not Applicable.	ntegy				
(U) (U)	E. Schedule Profile Not Applicable.					
P	roject 665A					

	RDT	&E BUDGET ITEM JL	JSTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	nry 2002
BUDO 03 -	SET ACTIVITY Advanced Te	chnology Development			PE NUMBE 060320	R AND TITLE	inced Ae	rospace	Sensors		PROJECT 69DF
	COST	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost	
69DF	Target Attack a	nd Recognition Technology	27,618	43,580	34,623	25,868	21,889	22,164	21,451	Continuing	TBD
In F Proje	n FY 2003, efforts in advanced radio frequency technologies for intelligence, surveillance, and reconnaissance previously performed in this project will transfer to this PE, Project 5019.										
) A. Mission Description This project develops and demonstrates advanced technologies for attack management, fire control, and target identification and recognition. This includes developing and demonstrating integrated and cooperative fire control technologies under development include attack management, sensor fusion, automated decision aids, advanced tracking for low radar cross section threats, and targeting using both on-board and off-board sensor information. This project also evaluates targeting techniques to support theater missile defense efforts in surveillance and attack. These fire control technologies will provide for emultiplication and reduce warfighter exposure to hostile fire. This project also develops and demonstrates target identification and recognition technologies for positive, high confidence cueing, recognition, and identification of airborne and ground-based, high-value, time-critical targets at longer ranges than are currently possible. The goal is to apply these technologies to tactical air-to-air and air-to-surface weapon systems so they are able to operate in all weather conditions, during day or night, and in high-threat, multiple target environments. Model-based vision algorithms and target signature development techniques are the key to target identification and recognition. This project is maturing these technologies in partnership with the Defense Advanced Research Projects Agency (DARPA), and evaluating the techniques to support theater missile defense efforts in surveillance and attack. Fire control and recognition technologies developed and demonstrated in this project are high leverage efforts, providing for										
(U) (U)	<u>FY 2001 (\$ in The</u> \$2 347	<u>ousands)</u> Developed advanced situation	nal awarenes	ss technolog	ies for rapid	detection la	ocation and 1	prosecution	of time-critic	al targets T	Demonstrated
(0)	φ2,3+7	algorithms for multisensor fu	sion of on- a	and off-board	data and in	lages.	Cation, and p	of oscention (ai targets. I	Jemonstrated
(U)	\$1,346	Developed and demonstrated	technologie Continued	s for real-tin	ne informatio	on in- and ou	it-of-the-coc	kpit for imp	roved situati	onal awaren	ess. Completed
(U)	\$1,823	Developed and evaluated rada targets. Conducted risk reduc strike and reconnaissance pla	ar automatic ction activiti tforms.	target recog es to improv	inition (ATR e affordabili	.) algorithms ty and the sr	for tracking	and identify tion of techn	ying moving ology via pl	and stationa anned sensor	ry ground r upgrades to
(U)	\$835	Developed target recognition	concepts us	ing hyperspe	ectral imagin	g data and o	ther candida	te sensor inp	puts to deter	mine require	ments for ATR

	RDT&I	E BUDGET ITEM JUSTIFICAT	ION SHEET (R-2A Exhibit)	DATE February 2002						
вирс 03 -	GET ACTIVITY - Advanced Tech	nology Development	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sens	PROJECT SORS 69DF						
(U)	A. Mission Descript	ion Continued								
(U)	FY 2001 (\$ in Thous	ands) Continued								
(U)	 \$3,108 \$3,108 and target/background phenomenology efforts. Evaluated algorithms using hyperspectral imaging data. Continued testing and integrating Defense Advanced Research Projects Agency (DARPA) multi-sensor Automatic Target Recognition (ATR) fusion algorithms into the Air Force ATR evaluation test facility for application to Air Force intelligence, surveillance, and reconnaissance missions 									
(U)	 \$4,159 beveloped advanced tactical targeting technology in conjunction with DARPA for suppression of enemy air defenses. Optimized targeting algorithms and techniques. Modified brassboard units that triangulate threat emitter position and provide targeting for precision guided munitions. (In EX 2002, this effort transfers to PE 0603270E, Project 2432.) 									
(U)	 \$3,500 \$3,500 Developed Integrated Demonstrations and Applications Laboratory technology. Performed integration of infrared (IR) and radio frequency (RF) sensors to simulate battlefield-condition sensor operation at dramatically reduced cost. 									
(U)	\$10,500	Developed a National Radar Signature Produc radar signature libraries necessary to discrimir	tion and Research Capability (RCAS). Developed computer n nate friend, foe, and neutral targets.	nodeling and simulation of aircraft						
(U)	\$27,618	Total								
(U)	FY 2002 (\$ in Thous	ands)								
(U)	\$1,193	Develop advanced global awareness and preci of time-critical targets. Integrate modeling, sin time-critical targeting, emphasizing the difficu obscure or conceal the targets of interest durin	sion engagement automated targeting technologies for rapid de mulation, and analysis testbed to determine ATR and informat ilt targeting missions where weather, terrain, foliage, camoflau g most of their deployment cycles.	etection, location, and prosecution ion fusion algorithms for ge, or deception techniques						
(U)	\$3,230	Develop common, open system technologies f awareness, target nomination, and target engag location data for use on special operations for	or integrating real-time information in- and out-of-the-cockpit gement capabilities. Demonstrate a capability to fuse all-sourc ces aircraft.	to improve aircrew situational e threat, target, and survivor						
(U)	 \$2,718 Develop and evaluate radar ATR algorithms for tracking and identifying moving and stationary ground targets. Continue demonstration of affordable risk reduction for transition via planned sensor upgrades to strike and reconnaissance platforms. These algorithms will significantly impact the capability to find, fix, track, target, engage, and assess time-critical targets in all phases of deployments, including active and passive communication and emission states; during hide in foliage; and either moving or stationary. 									
(U)	\$873	Develop ATR solutions using hyperspectral in technology to recognize and identify targets us	naging data and other candidate sensor inputs. Develop target sing hyperspectral imaging data. Conduct performance analyse	and background phenomenology es on candidate algorithms using						
Р	Project 69DF		Page 10 of 13 Pages	Exhibit R-2A (PE 0603203F)						

	RDI&I	BUDGET TIEM JUSTIFICATI	February 2002							
budge 03 - A	et activity Advanced Tech	nology Development	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sen	PROJECT SORS 69DF						
(U) <u>A</u>	A. Mission Descript	ion Continued								
(U) <u>F</u>	FY 2002 (\$ in Thous	ands) Continued								
(U) \$	 \$2,796 \$2,796 \$2,796 Continue testing and integrating DARPA multi-sensor ATR fusion algorithms into the Air Force ATR evaluation test facility for application to Air Force intelligence, surveillance, and reconnaissance, strike, and weapon systems. Demonstrate impact to image analysts and Air Operation Center decision makers of automated multi-sensor Automatic Target Recognition (ATR) and fusion capability on sensor-to-shooter timeline 									
(U) \$	reductions for time-critical targeting. \$25,441 Develop technology to detect and identify targets under trees. Design and fabricate a very-high frequency (VHF) foliage penetration radar. Develop and implement VHF radar change detection algorithms for robust target detection with a low false alarm rate. Perform VHF radar data collections for algorithm development and foliage penetration characterization. Develop imagery exploitation algorithms for target identification sensor fusing techniques. Perform high fidelity modeling of the VHF radar, change detection capability, data fusion process, and weapon effectiveness. Develop integration plans for a warfighter-selected operational platform. Develop and demonstrate air-to-ground radar imaging technology and reliable combat identification technology to enable capability to detect and target difficult, concealed, and									
(U) \$ (U) \$	\$7,329 \$43,580	Continue developing a National Radar Signatur discriminating friend, foe, and neutral targets in Total	e Production and Research Capability. Develop, validate, an to aircraft radar signature computer modeling and simulation	nd begin integrating data libraries n tools.						
(U) F	FY 2003 (\$ in Thous	ands)								
(U) \$	 \$2,006 \$2,006 Develop modeling and simulation to show enhanced global awareness and precision engagement capability for warfighters, as enabled by automated targeting technologies for rapid detection, location, and prosecution of time-critical targets. Employ the modeling, simulation, and analysis testbed to analyze and demonstrate ATR and information fusion algorithms for time-critical targeting, emphasizing the difficult targeting missions where weather, terrain, foliage, camouflage, and deception techniques obscure or conceal the targets of interest. Develop and employ air and ground target signature generation models to support automated target signature exploitation in automatic target recognizer and multi-sensor fusion algorithms. Generate synthetic target signatures for automated signature exploitation of radio frequency and electro-optical sensor data. \$1.818 									
		battlespace situational awareness, target nomina threat, imagery, target, and survivor location da	ation, and target engagement capabilities. Demonstrate initia ta using an airborne platform digitally linked to airborne cor	al capability to fuse all-source nbat search and rescue assets.						
Pro	oject 69DF		Page 11 of 13 Pages	Exhibit R-2A (PE 0603203F)						

	RD	T&E BUDGET ITEM JUSTIFICAT	DATE	February 2002			
BUDO	GET ACTIVITY		PE NUMBER AND TITLE	<u> </u>	PROJECT		
03 -	Advanced	Technology Development	0603203F Advanced A	erospace Sensors	69DF		
(U)	A. Mission Des	scription Continued					
(U) (U)	<u>FY 2003 (\$ in 7</u> \$5,160	<u>Chousands) Continued</u> Continue developing and testing an ATR syst reconnaissance platforms. Integrate advanced processing. Advance the state-of-the-art for r risk reduction. Continue analysis of requirem reconnaissance platforms.	em for tracking and identifying moving an l stationary target identification techniques noving target identification techniques and tents and affordable risk reduction for trans	d stationary ground targets for and algorithms with synthed algorithms by providing tec sition via planned sensor upg	or use in strike and tic aperture radar chnology maturation and grades to strike and		
(U)	\$3,766	Test and integrate Air Force and Defense Adv fusion algorithms into the Air Force ATR eva and weapon systems. Characterize single and with automated exploitation. Continue demon ATR and fusion capability on timeline reduct	vanced Research Projects Agency (DARPA luation test facility for application to Air F l multisensor contributions from radar and nstrating to image analysts and Air Operat ions for time-critical targeting.	A) multi-sensor automatic tar Force intelligence, surveilland electro-optic (including hype ion Centers decision makers	get recognition (ATR) ce, reconnaissance, strike, erspectral imaging) sensors of automated multi-sensor		
(U)	\$12,973	Develop technology to detect, identify, and er and algorithms for robust target detection and Preparation of the Battlefield for improved tra multi-intelligence georegistration. Perform er encompass the entire kill chain cycle. Perforn processes. Develop integration plans with wa georegistration; and concepts of employment.	ngage targets under trees (TUT). Characte tracking with low probability of false alar acking, detection, sensor management, and nd-to-end modeling for the TUT family of m virtual simulations to identify system int arfighter-selected operational systems. Tes	rize performance of foliage p ms. Develop TUT-specific t target identification and loca systems, providing measures tegration issues, human decis st system functionality, inclu-	penetration radar sensors tools Intelligence ation. Develop tools for s of effectiveness that sion functions, and system ding fusion and		
(U)	(ATR/C) capability for stationary and moving targets under the Air-to-Ground Radar Imaging effort. Continue developing a follow-on, high confidence combat identification capability under the Reliable Combat Identification for Surface Targeting effort. Characterize advanced stationary and moving target radar data to determine its utility for ATR/C and combat identification. Develop tools to support sensor system, sensor management, and system performance analyses. Characterize the performance of identification techniques for multiple moving targets. Perform advanced multi-sensor data collection on stationary and moving targets. Determine which combination of sensors, modes, and fusion processing						
(U)	\$34,623	Total					
Р	roject 69DF		Page 12 of 13 Pages	Exh	nibit R-2A (PE 0603203F)		
			282				

	RDT&E BUDGET ITEM JUSTIFICATION S	SHEET (R-2A Exhibit)	DATE February 2002
BUD0 03 -	GET ACTIVITY • Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sense	PROJECT
(U)	<u>B. Project Change Summary</u> Not Applicable.		
(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602204F, Aerospace Sensors. PE 0603253F, Advanced Sensor Integration. PE 0603500F, Multi-disciplinary Adv Space Tech. PE 0603762E, Sensor and Guidance Technology. PE 0603270F, Electronic Combat Technology. PE 0603270F, Electronic Combat Technology. Theater Missile Defense System Program Office. Low Altitude Night Targeting and Infrared Navigation (LANTIRN) System F This project has been coordinated through the Reliance process to harmonize	Program Office. efforts and eliminate duplication.	
(U)	D. Acquisition Strategy Not Applicable.		
(U) (U)	E. Schedule Profile Not Applicable.		
Р	Project 69DF Page	13 of 13 Pages	Exhibit R-2A (PE 0603203F)
		283	

THIS PAGE INTENTIONALLY LEFT BLANK

	RDT&E BUDGET ITEM J	USTIFIC	ATION	SHEET	(R-2 Ex	chibit)		DATE	Februa	ry 2002
budo 03 -	BET ACTIVITY Advanced Technology Development			PE NUMBE 060320	r and title 5F Fligh	t Vehicle	Technol	ogy		
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	10,685	4,556	0	0	0	0	0	Continuing	TBD
2978	Flight Vehicle Technologies	3,092	0	0	0	0	0	0	Continuing	TBD
4398	Air Base Technology	7,593	4,556	0	0	0	0	0	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0
(U)	aerospace venicle performance, decreased vulnerabli including airfield pavements, energy systems, air bas Congress added \$1.8 million for AFRL [Air Force R protection, and \$2.8 million for E-SMART Chemica B. Budget Activity Justification This program is in the Budget Activity 3, Advanced	se survivabil esearch Lab l and Biolog	ity, air base oratory] Tyr ical Sensors	nt, since it d	otective syst pon systems evelops and	demonstrate	strates technologi s technologi	e systems tec e systems tec	ng aerospace	e base assets, FY 2002, d force vehicle system
an an	C Program Change Summary (\$ in Thousands)	military uti	itty and addi	ess warnight	er needs.					
(U) (U) (U)	Previous President's Budget Appropriated Value Adjustments to Appropriated Value a. Congressional/General Reductions				<u>FY 200</u> 10,944 11,045	1 <u>1 F</u> 4 5	<u>Y 2002</u> 0 4,600 -44	<u>FY 200</u>	0 <u>3</u> 0	<u>Total Cost</u>
			Pag	e 1 of 6 Page	es			E	Exhibit R-2 ((PE 0603205F)
				285						

	RDT&E BUDGET ITEM JUSTIFICATION	DATE Februa	DATE February 2002		
BUDO 03 -	GET ACTIVITY • Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Ve	ehicle Technolog	gy	
(U)	C. Program Change Summary (\$ in Thousands) Continued b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram	<u>FY 2001</u> -259	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>
(U) (U)	e. Rescissions Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR	-101 10,685	4,556	0	TBD
	In FY 2002, Project 2978, efforts transferred to PE 0603211F, Project 4920	and Project 4398, efforts trans	sferred to PE 0603112	F, Project 4918.	
	Pag	ge 2 of 6 Pages		Exhibit R-2	(PE 0603205F)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)										Februa	iry 2002
виро 03 -	BET ACTIVITY Advanced Tech	nnology Development			PE NUMBE	R AND TITLE	t Vehicle	Technol	ogy		PROJECT 2978
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2978	Flight Vehicle Tech	nologies	3,092	0	0	0	0	0	0	Continuing	TBD
Note	In FY 2002, Project 2	2978, efforts transferred to PE 0	603211F, Pi	roject 4920.							
(U)	A. Mission Description This program develops and demonstrates advanced manned and unmanned aerospace flight controls, and vehicle-pilot interface technologies for improved aerospace vehicle performance, decreased vulnerability, and reduced logistics support.										
(U) (U)	 <u>FY 2001 (\$ in Thousands</u>) \$201 Continued development of aerospace vehicle air-to-air collision avoidance technologies to increase tactics flexibility and increase aerospace vehicle survivability. Continued development of air collision avoidance technologies previously developed and simulated for a limited number of manned aircraft and Unmanned Air Vehicles (UAVs) to larger flights of UAVs. Initiated integration of the auto air collision avoidance algorithms into vehicle management systems architecture and validate in a laboratory environment 										
(U)	\$533	Demonstrated optical control eliminate electromagnetic inte control technologies.	technologies erference pro	s to integrate oblems in air	e power and vehicle con	control syste trol systems	ems to signif . Conducted	icantly decre l physical sy	ease system stem ground	volume and I demonstrat	weight and to ion of optical
(U)	\$958	Developed advanced concepts logistics support requirements	s for engine 6. Complete	nacelle balli ground dem	stic impact f ionstration o	ire suppressi f nacelle bal	ion to increa listic fire su	se survivabi ppression co	lity, while de ncepts.	ecreasing bo	th cost and
(U) (U)	\$1,400 \$3,092	Initiated Congressionally dire Total	ected efforts	to address d	levelopment	issues assoc	iated with f	iber optics c	ontrol techn	ologies.	
(U) (U)	<u>FY 2002 (\$ in Thous</u> \$0	ands) Efforts transferred to PE 0603	211F, Proje	ct 4920.							
(U)	\$0	Total									
(U)	FY 2003 (\$ in Thous	ands)									
(U) (U)	\$0 \$0	No Activity Total									
P	roject 2978			Page	e 3 of 6 Page	S			Ex	hibit R-2A	(PE 0603205F)

	RDT&E BUDGET ITEM JUSTIFICATION S	SHEET (R-2A Exhibit)	DATE February 2002
виро 03 -	BET ACTIVITY • Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology	PROJECT 2978
(U)	B. Project Change Summary Not Applicable.		
(U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602201F, Aerospace Vehicle Technology PE 0603216F, Aerospace Propulsion and Power. This project has been coordinated through the Reliance process to harmonize	efforts and eliminate duplication.	
(U)	D. Acquisition Strategy Not Applicable.		
(U) (U)	E. Schedule Profile Not Applicable.		
P	roject 2978 Page	e 4 of 6 Pages	Exhibit R-2A (PE 0603205F)
		288	

	RDT&	E BUDGET ITEM JU	STIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ary 2002
budo 03 -	BET ACTIVITY Advanced Tec	hnology Development			PE NUMBE	r and title 5F Fligh	t Vehicle	Technol	ogy		PROJECT 4398
	COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4398	Air Base Technolo	дх	7,593	4,556	0	0	0	0	0	Continuing	TBD
Note	In FY 2002, Project	4398 efforts transferred to PE 0	503112F, Pr	oject 4918.	1						
(U)	J) <u>A. Mission Description</u> This project develops technologies for fixed and bare base operations, including airfield pavements, energy systems, air base survivability, air base recovery, protective systems, airfield fire protection, and crash rescue. Note: In FY 2002, Congress added \$1.8 million for AFRL[Air Force Research Laboratory] Tyndall to conduct efforts in weapon systems logistics, deployed base systems technology, and force protection, and \$2.8 million for E-SMART Chemical and Biological Sensors.										
(U)	FY 2001 (\$ in Thous	sands)									
(U)	\$134	Developed aircraft and air bas Continued development of pr concepts.	se fire fightin otective fire	ng and powe fighting clot	er generation thing and fir	technologie e risk assess	s to improve ment techno	e fire fighting logies. Eval	g rescue. Te uated new fi	ested safe fire ire fighting t	e fighting agents. raining
(U)	\$125	Developed technologies, util demonstration that reduces ai	ities, and she rlift requirer	elters that im nents in supj	prove air ba	se operation space Exped	s. Complet itionary For	ed the acous	tic cycle hea s rapid deplo	at pump tech oyment.	nology
(U)	\$134	Constructed an air transportal rapid deployment.	ole shelter ac	lvanced deve	elopment mo	odel for field	testing to su	ipport Aeros	pace Exped	itionary Ford	ce operations
(U)	\$3,000	Continued directed E-SMAR' monitoring technologies into	Г Warning a the E-SMAI	nd Response RT.	e System eff	ort that deve	lops and inte	egrates chem	ical and bio	logical sense	or and
(U)	\$4,200	Initiated Congressional direc airfield assessment, improved	ted effort to lightweight	expand effo	rts related to ting, and mo	providing in ore efficient	ncreased exp deployable u	olosion mitig	ation, increa	ased ability t	o conduct rapid
(U)	\$7,593	Total			-						
Р	roject 4398			Page	e 5 of 6 Page	es			Ex	hibit R-2A	(PE 0603205F)
					280						

Γ	RD	T&E BUDGET ITEM JUSTIFIC	DATE February 2002							
BUDO 03 -	GET ACTIVITY Advanced	Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Techi	PROJECT 10logy 4398						
(U)	A. Mission De	escription Continued								
(U) (U)	<u>FY 2002 (\$ in</u> \$1,783	Thousands) Continue Congressional directed effort r	related to providing increased explosion mitigation, increas	ed ability to conduct rapid airfield						
(U)	\$2,773	Continue Congressional directed E-SMA the E-SMART system.	ART effort that develops and integrates chemical and biolog	gical senor and monitoring technologies into						
(U)	\$4,556	Total								
(U) (U) (U)	<u>FY 2003 (\$ in</u> \$0 \$0	<u>Thousands)</u> No Activity Total								
(U)	<u>B. Project Ch</u> Not Applicable	ange Summary e.								
(U) (U) (U) (U) (U)	C. Other Prog Related Activit PE 0602201F, PE 0603231F, This project ha	ram Funding Summary (\$ in Thousands) ies: Aerospace Vehicle Technologies Crew Systems and Personnel Protection Technol s been coordinated through the Reliance process	logy. to harmonize efforts and eliminate duplication.							
(U)	D. Acquisition Not Applicable	<u>Strategy</u>								
(U) (U)	E. Schedule Pr Not Applicable	<u>cofile</u>								
P	roject 4398		Page 6 of 6 Pages	Exhibit R-2A (PE 0603205F)						
			290							
	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exh							DATE	Februa	ary 2002
---	--	-------------------	---------------------	---------------------	--	---------------------	---------------------	---------------------	---------------------	------------
BUDGET ACTIVITY 03 - Advanced Technology Development				PE NUMBE 060321	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo					
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	17,675	22,945	22,315	25,455	28,445	28,992	29,541	Continuing	TBD
486U	Advanced Aerospace Structures	17,675	6,538	4,937	5,478	6,003	6,033	6,156	Continuing	TBD
4920	Flight Vehicle Tech Integration	0	16,407	17,378	19,977	22,442	22,959	23,385	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	Continuing	TBD

Note: Beginning in FY 2002, Project 4920 contains the ongoing technical efforts from PE 0603205F, Project 2978, and PE 0603245F, Project 2568, in order to align projects with the Air Force Research Laboratory organization.

(U) <u>A. Mission Description</u>

The demonstration and transition of advanced aerospace vehicle technologies are accomplished in this program. The two project areas are advanced aerospace structures and flight vehicle technology integration. Advanced aerospace structures are demonstrated to sustain and enhance the capability of current and future aerospace vehicles. Flight vehicle technology integration is accomplished through system level integration of various technologies to include avionics, propulsion, and weapon systems for demonstration in near-realistic operational environments. Note: In FY 2002, Congress added \$1.0 million for three-dimensional woven preform composites, \$1.4 million for Access-to-Space Joint Systems Program Office, \$4.9 million for Aeronautical Systems Center, and \$1.5 million for affordable combat avionics initiative.

(U) <u>B. Budget Activity Justification</u>

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

Page 1 of 9 Pages

Exhibit R-2 (PE 0603211F)

	RDT&E BUDGET ITEM JUSTIFIC	DATE Febru	February 2002		
BUD	GET ACTIVITY	PE NUMBER AND TITLE			
03 ·	Advanced Technology Development	0603211F Aerospac	y Dev/Demo		
(U)	C. Program Change Summary (\$ in Thousands)				
		<u>FY 2001</u>	FY 2002	FY 2003	Total Cos
(U)	Previous President's Budget	18,291	26,269	22,469	
(U)	Appropriated Value	18,461	23,169		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions		-224		
	b. Small Business Innovative Research	-433			
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram	-183			
	e. Rescissions	-170			
(U)	Adjustments to Budget Years Since FY 2002 PBR			-154	
(U)	Current Budget Submit/FY 2003 PBR	17,675	22,945	22,315	TBD
(U)	Significant Program Changes:				
	Not Applicable.				

Page 2 of 9 Pages

	RDT&I	E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
вира 03 -	GET ACTIVITY • Advanced Tech	nnology Development			PE NUMBER AND TITLE 0603211F Aerospace Technology Dev					PROJECT //Demo 486U	
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
486U	Advanced Aerospa	ce Structures	17,675	6,538	4,937	5,478	6,003	6,033	6,156	Continuing	TBD
(U)	A. Mission Description This project develops and demonstrates affordable aerospace vehicle technologies to sustain the existing fleet, reduce the cost of aircraft ownership, and enhance the capability of current and future aerospace vehicles. Sustainment of the existing fleet through their extended operational service life with innovative technology application will lead to reduced operations and support costs and increased operational readiness. Analytical certification will reduce the cost associated with component replacement by allowing and certifying new designs under reduced test requirements. Development of capability enhancing technologies will expand the operational envelope and increase survivability in high threat environments. Demonstration of these technologies will restore structural integrity, extend structural life, enhance the capability, and reduce the life cycle costs of fielded aircraft. Note: In FY 2002, Congress added \$1.0 million for three-dimensional woven preform composites.										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$4,382	ands) Continued improvement in du and support costs and extend effects of fatigue, corrosion, a repair cost, reduce inspection	urability and usable struct and damage. cost. and in	affordability tural lives. I Developed crease aircra	y of existing Developed a and validate ft availabilit	aging aircra dvanced met low-cost ad	ft and future hods for pre lvanced met	e aerospace v dicting struct nods to resto	vehicle struc ctural streng ore original s	tures for red th and life re structural inte	uced operations maining due to egrity, reduce
(U)	\$1,003	Developed advanced design c weapons employment envelop eliminating fatigue in weapon expanding aircraft store (fuel	concepts and pe and reduc is bay areas. tanks, weap	methods to e fatigue rel Evaluated a ons, space, e	suppress aer ated failures aerodynamic etc.) and airc	co-acoustic n . Investigate airflow con raft release e	oise and vib e concepts to trol devices envelope.	ration in adv reduce life to improve	vanced aircra cycle cost o weapons sys	aft weapons of aircraft by stem perform	bays to expand reducing or ance by
(U)	\$1,069	Developed advanced structura Demonstrated, through flight airframe cost and weight for f	al concepts a test, the inci future air vel	and design m reased contro nicles.	nethods for f ol authority of	uture aerosp of an active a	ace vehicles aeroelastic w	for enhance ving and, the	d affordabil reby, transit	ity and highe	r performance. blogy to reduce
(U)	\$1,400	airframe cost and weight for future air vehicles. Demonstrated new analysis methods and design criteria for advanced composite structures to reduce life cycle costs of current and future aerospace vehicles by maximizing the use of composite structures. Continued to develop design concepts and structural criteria to implement lower cost manufacturing processes and materials in future airframes. Verified the structural integrity of affordable bonded unitized composite structure.									
P	roject 486U			Pag	e 3 of 9 Page	es			E	khibit R-2A	(PE 0603211F)

	RDT	&E BUDGET ITEM JUSTIFICAT		DATE February 2002				
BUDO					(D	PROJECT		
03 -	Advanced To	echnology Development	0603211F Aerospace Tec	chnology Dev	//Demo	486U		
(U)	A. Mission Desc	ription Continued						
(U)	FY 2001 (\$ in Th	ousands) Continued						
(U)	 \$4,321 Reduced susceptibility and increase survivability of existing and planned aircraft through demonstration of lightweight and low-cost electromagnetic infrared signature suppression capability. Applied new structural design specifications that allow smaller and damage tolerant inlet and exhaust engine ducts. Designed a full-scale structurally integrated airframe and turbine engine inlet and begin ground component testing. 							
(U)	\$4,000	Continued developing the processing and dor vehicles.	nestic production capability of constituent mate	erial for high stren	ngth polymeric fo	am for aerospace		
(U)	\$1,500	Initiated Congressionally directed efforts to a weight, non-corroding structural components	ccelerate development of three-dimensional we.	oven preform com	posite technolog	y to produce low		
(U)	\$17,675	Total						
(U)	<u>FY 2002 (\$ in Th</u>	ousands)						
(U)	\$2,305	Complete the development of analysis metho structural failure. Improve the ability to pred instances and levels of repair/replacement.	ds to accurately predict the impact of corrosion ict the effect of corrosion and corrosion treatm	n on the onset of c ents on structural	racking, crack pro integrity to great	ogression, and ly reduce		
(U)	\$2,197	Continue improvement in durability and affor and support costs and extend usable structura repair technology. While bonded repair is be be fully implemented on a larger class of pro- slow or stop crack growth allowing for a decr	rdability of existing aging aircraft and future ae l lives. Continue the development of technolog ing applied more frequently, several technical blems. Bonded repair can be used to reduce the rease in the frequency and magnitude for repair	erospace vehicle s gy required for fui challenges must b e frequency of cra r or replacement.	tructures for redu Il implementation we met so that this ack nucleation and	ced operations of bonded technology can d also used to		
(U)	\$1,045	Develop technologies that will extend aircraf methods will be developed to reduce dynamic originally intended. It will also result in decr	t life, increase aircraft availability, and reduce of cloads. This will result in the capability to consider a data and the capability to consider a data and the capability to consider a data and the capability is a data and the capability of the capacity of the capacit	operations and sup st-effectively and ynamically loaded	pport costs. Conc safely utilize airc l structure.	cepts and craft longer than		
(U)	\$991	Continue Congressionally directed efforts to low weight, non-corroding structural comport	accelerate development of three-dimensional we wents.	voven preform con	mposite technolog	gy to produce		
(U)	\$6,538	Total						
Р	roject 486U		Page 4 of 9 Pages		Exhibit R-2A	(PE 0603211F)		
			294					

	RDT&E BUDGET ITEM JUSTIFICATI	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)						
BUD(03 ·	GET ACTIVITY • Advanced Technology Development	PE NUMBER AND TITLE 0603211F Aerospace Technology De	PROJECT V/Demo 486U					
(U)	A. Mission Description Continued							
(U) (U)	FY 2003 (\$ in Thousands) \$2,165 Continue improvements in sustainment technologies for existing aging aircraft and future aerospace vehicle structures for reduced operations and support costs and extend usable structural lives. Continue the development of technology required for full implementation of bonded composite repair of thick and complex structures. Continue development of new analytical methods and techniques to expand bonded composite repair capability to thick and complex geometry structures enabling repair in lieu of replacement of primary load carrying structural components.							
(U)	 \$2,772 Develop innovative new non-traditional sustainment technologies that will extend aircraft life, increase aircraft availability, and reduce operation and support costs. Continue development of unitized composite structures to replace mechanically fastened built up components that are highly susceptible to damage from dynamic in-service usage resulting in elimination of maintenance actions due to loose fasteners and fastener hole damage. 							
(U)	\$4,937 Total							
(U)	B. Project Change Summary Not Applicable.							
(U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602201F, Aerospace Vehicle Technologies PE 0603333F, Unmanned Air Vehicle Dev/Demo PE 0604731F, Unmanned Combat Air Vehicle This project has been coordinated through the Reliance process to hard	monize efforts and eliminate duplication.						
(U)	D. Acquisition Strategy Not Applicable.							
(U) (U)	E. Schedule Profile Not Applicable.							
F	Project 486U	Page 5 of 9 Pages	Exhibit R-2A (PE 0603211F)					

	RDT&	E BUDGET ITEM JU	JSTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDO 03 -	GET ACTIVITY • Advanced Tec	hnology Development			PE NUMBE 060321	R AND TITLE	space Te	chnolog	y Dev/De	emo	PROJECT 4920
	COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4920	Flight Vehicle Tecl	h Integration	0	16,407	17,378	19,977	22,442	22,959	23,385	Continuing	TBD
Note with	: Beginning in FY 20 the Air Force Researc	02, this project contains the ong ch Laboratory organization.	oing technic	cal efforts fro	om PE 06032	205F, Projec	t 2978, and]	PE 0603245	F, Project 25	668, in order	to align projects
(U)	A. Mission Description This project integrates and demonstrates advanced flight vehicle technologies that will improve the performance and supportability of existing and future manned and unmanned aerospace vehicles. System level integration brings together the aerospace vehicle technologies along with avionics, propulsion, and weapon systems for demonstration in a near-realistic operational environment. Integration and technology demonstrations reduce the risk and time required to transition technologies into operational aircraft. This program provides proven aerospace vehicle technologies for all-weather, day/night operations with significantly improved performance and affordability.										
(U) (U) (U)	<u>FY 2001 (\$ in Thous</u> \$0 \$0	<u>sands)</u> Efforts were performed in PE Total	0603205F,	Project 2978	3, and PE 06	03245F, Pro	ject 2568.				
(U) (U)	<u>FY 2002 (\$ in Thous</u> \$4,110	sands) Develop and validate novel consistent while providing miss Complete the simulation asseut unmanned vehicles. Integrated	ontrol auton sion respons ssment of in e unmanned	nation techni iveness and a telligent-age vehicle soft	ques and alg adaptability : ent-based alg ware with ph	orithms to e for improved orithms and otonic vehic	nable the sat l operational modular solution the managem	fe and intero l effectivene ftware system lent system l	perable appl ss of manne m architectu hardware.	lication of un d and unman re for cooper	manned vehicle ned systems. ative control of
(U) (U)	 \$848 Bemonstrate and validate advanced control mechanization technologies to provide highly reliable operation for manned and unmanned systems at significantly reduced size, weight, and cost. Complete advanced development and demonstration of direct optical control and interfacing of vehicle management and more-electric subsystems. Transfer technology to unmanned air vehicle control integration efforts. Assess benefits of applying photonic technologies to vehicle and health management for military space access systems. \$1,515 										
Р	roject 4920	high frequency multi-element aerodynamic technologies that	t antenna arr at enable stru	ays in load b acturally inte Pag	bearing struc egrated highl e 6 of 9 Page	ture for ante y survivable es	nna perform and mainta	ance improv inable inlet a	vement. Mat and exhaust : Ex	systems. systems.	(PE 0603211F)

	RD	T&E BUDGET ITEM JUSTIFICATION	DATE February 2002						
BUDC 03 -	GET ACTIVITY • Advanced T	echnology Development	PE NUMBER AND TITLE 0603211F Aerospace Technology De	PRC ev/Demo 49:)JECT 20				
(U)	A. Mission Des	cription Continued							
(U)	FY 2002 (\$ in T	housands) Continued							
(U)	\$1,768 Demonstrate new analysis methods and design criteria for advanced composite structures to reduce life cycle costs of current and future aerospace vehicles by maximizing the use of composite structures. Develop design concepts and methods to allow more widespread use of low-cost bonded structure with particular attention to verification of analyses methods through test articles.								
(U)	 \$441 Develop advanced structural concepts and design methods for future aerospace vehicles for enhanced affordability and higher performance. Complete flight test demonstration of the increased control authority of an active aeroelastic wing, and transition technology to reduce airframe cost and weight for future air vehicles. 								
(U)	\$1,387	Initiate Congressional directed efforts to establish	sh an Access-to-Space Joint System Program Office.						
(U)	\$4,853	Initiate Congressional directed efforts with Aero	onautical Systems Center.						
(U)	\$1,485	Initiate Congressional directed efforts for afford	able combat avionics initiatives.						
(U)	\$16,407	Total							
(U)	FY 2003 (\$ in T	housands)							
(U)	\$5,320	Develop and demonstrate key control automation vehicle systems. Continue development and development and development and modular	n techniques and algorithms to enable the safe and interoper monstrate hardware and algorithms for automated air collisi software system architecture for cooperative control of unm	able application of unmanned on avoidance. Flight demons anned aerospace vehicles syst	1 aerial strate tems.				
(U)	\$4,193	Develop an integrated control technology suite to Complete baseline systems architecture combining autonomous, trajectory-generating outer-loop co	to provide significantly increased reliability and mission effecting compact, low-cost hardware with adaptive, fault tolerant portrol. Develop, test, and verify component technologies for	ctiveness for air vehicle syste inner-loop control and systems integration.	ems.				
(U)	\$362	Demonstrate and validate advanced control mec systems at significantly reduced size, weight, an interfacing of vehicle management and more-ele	hanization technologies to provide highly reliable operation d cost. Complete advanced development and demonstration ectric subsystems.	s for manned and unmanned of direct optical control and					
(U)	\$1,886	Develop multi-functional integrated structures to of air vehicles. Continue development of conce enable increased antenna performance and new multifunction structures with embedded electric thermal management to minimize vehicle weight	o reduce acquisition costs, support costs, weight, and volum pts with embedded high frequency multi-element antenna ar capabilities at reduced cost, weight, and volume. Develop h al conductors and data cabling, health monitoring networks, it, volume, and acquisition and support costs.	e while increasing the perform rays in load bearing structures ighly efficient and durable fuel handling and sensing, an	nance s to nd				
(U)	\$1,997	Develop integral airframe technologies to enable	e increased propulsion system performance. Complete demo	onstration of inlet duct concept	pts				
Р	roject 4920		Page 7 of 9 Pages	Exhibit R-2A (PE 0603	211F)				

	RD	T&E BUDGET ITEM JUSTIFIC	DATE Februa	ary 2002					
BUDO 03 -	GET ACTIVITY	Technology Development	PE NUMBER AND TITLE 0603211F Aerospace Techno	ology Dev/Demo	PROJECT 4920				
(U)	A. Mission De	scription Continued							
(U)) <u>FY 2003 (\$ in Thousands) Continued</u> with advanced aerodynamic technologies that enable structural integration, enhanced performance, survivability, and increased propulsion system performance. Develop conformal inlet concepts with advanced aerodynamic technologies that enable higher efficiency propulsion systems.								
(U)	 \$2,106 Develop advanced structural concepts and design methods to significantly enhance the affordability and increase the performance of current and future aerospace vehicles. Continue development of new analysis methods, design concepts, and design criteria to enable low-cost unitized composite structures. Continue development of demonstration articles for test verification of analyses methods, design concepts, and design criteria. 								
(U)	 \$1,514 Develop affordable advanced aero-structural concepts and design methods to enable new performance capabilities for future aerospace vehicles. Continue flight test demonstration of the increased high speed control authority of an active aeroelastic wing. Develop concepts applying continuous moldline technologies to reduce aerodynamic drag and electromagnetic signature for reconfigurable structures to enable maximum warfighting capability and versatility in a single platform. Develop highly efficient wing concepts integrating active aeroelastic design concepts, adaptive structures, and aerodynamic flow control technologies to enable new capabilities for long-range air vehicles and long and were unbilities. 								
(U)	\$17,378	Total							
(U)	<u>B. Project Cha</u> Not Applicable	ange Summary 2.							
(U) (U) (U) (U) (U) (U)	 J. C. Other Program Funding Summary (\$ in Thousands) J. Related Activities: J. PE 0602201F, Aerospace Flight Dynamics. J. PE 0603333F, Unmanned Air Vehicle Dev/Demo. J. PE 0604731F, Unmanned Combat Air Vehicle. J. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. 								
(U)	D. Acquisition Not Applicable	<u>Strategy</u>							
(U)	<u>E. Schedule Pr</u>	ofile							
Р	Project 4920		Page 8 of 9 Pages	Exhibit R-2A	(PE 0603211F)				

	RDT&E BUDGET ITEM JUSTIFIC	DATE February 2002					
BUD 03 ·	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603211F Aerospace Technology I	PROJECT Dev/Demo 4920				
(U) (U)	E. Schedule Profile Continued						
(0)	The second s						
F	Project 4920	Page 9 of 9 Pages	Exhibit R-2A (PE 0603211F)				
	299 UNCLASSIFIED						

THIS PAGE INTENTIONALLY LEFT BLANK

PE TITLE: Aerospace Propulsion and Power Technology

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 2002	
budge 03 - A	BUDGET ACTIVITY 03 - Advanced Technology Development				PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology					
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	41,722	121,548	85,650	72,863	66,163	69,350	71,480	Continuing	TBD
2480	Aerospace Fuels and Atmospheric Propulsion	3,417	12,380	7,675	8,201	8,248	9,292	10,329	Continuing	TBD
3035	Aerospace Power Technology	2,688	4,602	6,240	4,312	4,390	4,475	4,560	Continuing	TBD
4921	Aircraft Propulsion Subsystems Int	0	37,479	35,783	28,914	25,217	26,671	27,116	Continuing	TBD
4922	Space & Missile Rocket Propulsion	0	30,607	1,464	1,507	1,553	1,617	1,664	Continuing	TBD
681B	Advanced Turbine Engine Gas Generator	35,617	36,480	34,488	29,929	26,755	27,295	27,811	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: In FY 2002, all turbine engine technology efforts performed in PE 0603202F, Project 668A, are transferred to PE 0603216F, Project 4921. Also in FY 2002, all rocket propulsion technology efforts performed in PE 0603302F, Projects 4373 and 6340, are transferred to PE 0603216F, Project 4922, in order to align projects with the Air Force Research Laboratory organization. In FY 2003, space unique tasks in Project 4922 will be transferred to PE 0603500F, Project 5033, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

In FY 2003, this program anticipates receiving \$4.4 million from the Cost of War Transfer Account. These funds are not included in the FY 2003 Air Force baseline. Funding will be used for rocket propulsion technologies in support of the Technology for Sustainment of Strategic Systems program.

Page 1 of 22 Pages

Exhibit R-2 (PE 0603216F)

	RDT&E BUDGET ITEM JUSTIFICA	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							
BUD0 03 -	GET ACTIVITY • Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospac Technology	e Propulsion	and Power	•				
(U)	A. Mission Description This program develops and demonstrates technologies to achieve e and fuels. The program has five projects, each focusing on technol 1) The Advanced Turbine Engine Gas Generator project develops a 2) The Aerospace Propulsion Subsystem Integration project integrat components into demonstrator engines. 3) The Aerospace Power T The Space and Missile Rocket Technology project develops and de 5) The Aerospace Fuels and Atmospheric Propulsion project devel flight. Turbine engine propulsion projects are part of the Integrated within this program are part of the Integrated High Payoff Rocket I Joint Expendable Turbine Engine Concept demonstrator; \$4.4 mill Helicopter Demonstration for Combat Rescue.	enabling and revolutionary advances in the logies with high potential to enhance per and demonstrates core turbine engine tect ates the engine cores demonstrated in the Fechnologies project develops and demo emonstrates innovative rocket propulsion tops and demonstrates improved hydroca d High Performance Turbine Engine Tect Propulsion Technology (IHPRPT) progra- tion for the IHPRPT program; and \$2.0 m	urbine and rocket p formance of existi- chnologies for curre e Turbine Gas Gene nstrates power tech n technologies, pro- rbon fuels and adv chnology (IHPTET am. Note: In FY 2 nillion for Vectore	propulsion, power genering and future Air Force ent and future aircraft perator project with low- unologies for weapons a pellants, and manufacturanced propulsion syster) program. Rocket pro 2002, Congress added \$ d Thrust Ducted Propel	ration and storage, e weapons systems. propulsion systems. pressure and aircraft. 4) uring techniques. ms for hypersonic pulsion projects 52.0 million for the ler Compound				
(U)	B. Budget Activity Justification This program is in Budget Activity 3, Advanced Technology Deve system developments that have military utility and address warfigh	elopment, since it develops and demonstr nter needs.	rates technologies f	or existing system upg	rades and/or new				
(U)	<u>C. Program Change Summary (\$ in Thousands)</u>								
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>				
(U)	Previous President's Budget	43,413	114,335	96,161					
(U)	Appropriated Value	43,814	122,735						
(U)	Adjustments to Appropriated Value		1 107						
	a. Congressional/General Reductions	1.020	-1,18/						
	o. Small Business Innovative Research	-1,029							
	d Below Threshold Reprogram	-662							
	e Rescissions	-401							
(U)	Adjustments to Budget Years Since FY 2002 PBR			-10.511					
(U)	Current Budget Submit/FY 2003 PBR	41,722	121,548	85,650	TBD				
	Page 2 of 22 Pages				2 (PE 0603216F)				

	RDT&E BUDGET ITEM JUSTIFICATION	SHEET (R-2 Exhibit)	DATE February 2002
BUD(03 -	GET ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Technology	l Power
(U) (U)	C. Program Change Summary (\$ in Thousands) Continued Significant Program Changes: FY 2003 decreases are primarily due to transfer of space unique activities to b	PE 0603500F, Project 5033.	
	Page	3 of 22 Pages	Exhibit R-2 (PE 0603216F)

BUDGET ACTIVITY PENUMBER AND TITLE PROJECT 03 - Advanced Technology Development D603216F Aerospace Propulsion and Power 2480 cost cost FY 2001 FY 2002 FY 2003 FY 2005 FY 2005 FY 2007 Cost to Total Cost 2480 Aerospace Fuels and Atmospheric Propulsion 3.417 12.380 7.675 8.201 8.248 9.282 10.328 Continuing 1 2480 Aerospace Fuels and Atmospheric Propulsion 3.417 12.380 7.675 8.201 8.248 9.282 10.328 Continuing 1 2480 Aerospace Fuels and Atmospheric Propulsion 3.417 12.380 7.675 8.201 8.248 9.282 10.328 Continuing 1 2480 Aerospace Fuels and Atmospheric Propulsion 3.417 12.380 7.675 8.201 8.248 9.282 10.328 Continuing 1 2480 Stational demonstrates improved hydrocarbon fuels and advanced, novel aerospace propulsion systems, including systems for hypersonic flight and access to space. Emphasis is on developing and demonstrating ther		RDT	&E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ary 2002
COST (§ in Thousands) FY 2001 Actual FY 2002 Estimate FY 2003 Estimate FY 2004 Estimate FY 2006 Estimate FY 2007 Estimate Cost to Complete Total Cost 2480 Aerospace Fuels and Atmospheric Propulsion 3,417 12,380 7,675 8,201 8,248 9,292 10,329 Continuing 1 (1) A. Mission Description This project develops and demonstrates improved hydrocarbon fuels and advanced, novel aerospace propulsion systems, including systems for hypersonic flight and access to space. Emphasis is on developing and demonstrating new thermally stable, high heat sink, and controlled chemically reacting fuels. The project also develops and demonstrates fuel system components that minimize cost, reduce maintenance, and improve performance of future aerospace systems. (U) FY 2001 (S in Thousands) (U) S810 Continued demonstrating thermally stable JP-8+100 high heat sink fuel that reduce fuel system maintenance on current aircraft and provides greater cooling capacity (performance) for upgraded and future aircraft and missiles. Demonstrated fuel system simulator, the effects/benefits of thermally stable JP-8+100 for reduced maintenance in a variety of aircraft. Fabricated a sub-scale integrated fuel/air heat exchanger-combustor in a cooling air heat exchanger configuration, using fuel/air heat exchanger technology designed and fabricated in FY 2000. (U) \$3770 Demonstrated fuel/air heat exchanger configuration, using fuel/air heat exchanger technology designed and fabricated in FY 2000. (U)	BUDO 03 -	BET ACTIVITY Advanced Te	chnology Development			PE NUMBE 060321 Techno	FR AND TITLE	space Pr	opulsion	and Po	wer	PROJECT 2480
2480 Aerospace Fuels and Atmospheric Propulsion 3,417 12,380 7,675 8,201 8,248 9,292 10,329 Continuing 1 (U) Attribute Propertifies This project develops and demonstrates improved hydrocarbon fuels and advanced, novel aerospace propulsion systems, including systems for hypersonic flight and access to space. Emphasis is on developing and demonstrating new thermally stable, high heat sink, and controlled chemically reacting fuels. The project also develops and demonstrates fuel system components that minimize cost, reduce maintenance, and improve performance of future aerospace systems. (U) FY 2001 (S in Thousands) (U) \$810 Continued demonstrates the Pi-8+100 bigh heat sink fuel that reduce fuel system maintenance or advanced fighter configurations. (U) \$870 Demonstrated effectiveness of thermally stable JP-8+100 for reduced maintenance in a variety of aircraft. Fabricated a sub-scale integrated fuel/air heat exchanger-combustor in a cooling air heat exchanger configuration, using fuel/air heat exchanger technologies to support propulsion capabilities, improve the nation's aerospace research, development, and mandrafturing base, and address the growing shortfall within the aerospace specialized technological workforce. The focus on propulsion concepts and technologies for next generation military aerospace vehicles. These propulsion concepts will enable practical sustained hypersonic flight and affordable, routine military aerospace vehicles. These propulsion concepts will enable practical sustained hypersonic flight and affordable, routine military aerospace vehicles. These propulsion concepts will enable pract		COST ((\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
 (U) <u>A.Mission Description</u> This project develops and demonstrates improved hydrocarbon fuels and advanced, novel aerospace propulsion systems, including systems for hypersonic flight and access to space. Emphasis is on developing and demonstrating new thermally stable, high heat sink, and controlled chemically reacting fuels. The project also develops and demonstrates fuel system components that minimize cost, reduce maintenance, and improve performance of future aerospace systems. (U) <u>FY 2001 (S in Thousads)</u> (U) S810 Continued demonstrating thermally stable JP-8+100 high heat sink fuel that reduces fuel system maintenance on current aircraft and provides greater cooling capacity (performance) for upgraded and future aircraft and missiles. Demonstrated, in a sub-scale fuel system simulator, the effects/benefits of thermally stable JP-8+225 and other high heat sink fuels that reduce fuel system maintenance for advanced fighter configurations. (U) \$770 Demonstrated effectiveness of thermally stable JP-8+100 for reduced maintenance in a variety of aircraft. Fabricated a sub-scale integrated fiel/air heat exchanger-combustor in a cooling air heat exchanger configuration, using fuel/air heat exchanger technology designed and fabricated in FY 2000. (U) \$385 Demonstrated low-cost fuel-additive approaches to control particulate emissions from gas turbine engines. Demonstrated concepts for improving ignition and combustion in advanced engines. (U) \$1,452 Initiated investigation of a broad range of technologies to support propulsion capabilities, improve the nation's aerospace research, development, and manufacturing base, and address the growing shortfall within the aerospace specialized technological workforce. The focus on propulsion concepts and technologies for next generation military access to space. (U) \$3,417 Total 	2480	Aerospace Fuels	s and Atmospheric Propulsion	3,417	12,380	7,675	8,201	8,248	9,292	10,329	Continuing	TBD
 (U) \$770 Demonstrated effectiveness of thermally stable JP-8+100 for reduced maintenance in a variety of aircraft. Fabricated a sub-scale integrated fuel/air heat exchanger-combustor in a cooling air heat exchanger configuration, using fuel/air heat exchanger technology designed and fabricated in FY 2000. (U) \$385 Demonstrated low-cost fuel-additive approaches to control particulate emissions from gas turbine engines. Demonstrated concepts for improving ignition and combustion in advanced engines. (U) \$1,452 Initiated investigation of a broad range of technologies to support propulsion capabilities, improve the nation's aerospace research, development, and manufacturing base, and address the growing shortfall within the aerospace specialized technological workforce. The focus on propulsion concepts and technologies for next generation military aerospace vehicles. These propulsion concepts will enable practical sustained hypersonic flight and affordable, routine military access to space. (U) \$3,417 Total 	(U) (U) (U)	A. Mission Description This project develops and demonstrates improved hydrocarbon fuels and advanced, novel aerospace propulsion systems, including systems for hypersonic flight and access to space. Emphasis is on developing and demonstrating new thermally stable, high heat sink, and controlled chemically reacting fuels. The project also develops and demonstrates fuel system components that minimize cost, reduce maintenance, and improve performance of future aerospace systems. FY 2001 (\$ in Thousands) \$810 Continued demonstrating thermally stable JP-8+100 high heat sink fuel that reduces fuel system maintenance on current aircraft and provides greater cooling capacity (performance) for upgraded and future aircraft and missiles. Demonstrated, in a sub-scale fuel system simulator, the effects/benefits of thermally stable JP-8+225 and other high heat sink fuels that reduce fuel system maintenance for advanced fighter										
(U) \$385 Demonstrated low-cost fuel-additive approaches to control particulate emissions from gas turbine engines. Demonstrated concepts for improving ignition and combustion in advanced engines. (U) \$1,452 Initiated investigation of a broad range of technologies to support propulsion capabilities, improve the nation's aerospace research, development, and manufacturing base, and address the growing shortfall within the aerospace specialized technological workforce. The focus on propulsion concepts and technologies for next generation military aerospace vehicles. These propulsion concepts will enable practical sustained hypersonic flight and affordable, routine military access to space. (U) \$3,417 Total Project 2480 Page 4 of 22 Pages Exhibit R-2A (PE 0603216F)	(U)	\$770	Demonstrated effectiveness o fuel/air heat exchanger-comb fabricated in FY 2000.	f thermally s ustor in a co	stable JP-8+ oling air hea	100 for redu at exchanger	ced mainten configuratio	ance in a var on, using fue	riety of aircra l/air heat exc	aft. Fabrica changer tecl	ted a sub-sca mology desig	le integrated gned and
(U) \$1,452 Initiated investigation of a broad range of technologies to support propulsion capabilities, improve the nation's aerospace research, development, and manufacturing base, and address the growing shortfall within the aerospace specialized technological workforce. The focus on propulsion concepts and technologies for next generation military aerospace vehicles. These propulsion concepts will enable practical sustained hypersonic flight and affordable, routine military access to space. (U) \$3,417 Total Project 2480 Page 4 of 22 Pages Exhibit R-2A (PE 0603216F)	(U)	\$385	Demonstrated low-cost fuel-a improving ignition and comb	dditive appr ustion in adv	oaches to co vanced engir	ontrol particunes.	llate emissio	ns from gas	turbine engi	nes. Demo	nstrated conc	epts for
(U) \$3,417 Total Project 2480 Page 4 of 22 Pages Exhibit R-2A (PE 0603216F	(U)	 \$1,452 Initiated investigation of a broad range of technologies to support propulsion capabilities, improve the nation's aerospace research, development, and manufacturing base, and address the growing shortfall within the aerospace specialized technological workforce. The focus is on propulsion concepts and technologies for next generation military aerospace vehicles. These propulsion concepts will enable practical sustained hypersonic flight and affordable, routine military access to space. 										
Project 2480Page 4 of 22 PagesExhibit R-2A (PE 0603216F	(U)	\$3,417	Total									
	Р	roject 2480			Page	e 4 of 22 Pag	es			E	xhibit R-2A	(PE 0603216F)

	RDT	& E BUDGET ITEM JUSTIFICATION	SHEET (R-2A Exhibit)	DATE February 2002
BUD(03 -	GET ACTIVITY	chnology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Technology	PROJECT 2480
(U)	A. Mission Descri	ption Continued		
(U)	FY 2002 (\$ in Tho	usands)		
(U) (U)	\$3,950 \$3,450	Develop techniques for merging the scramjet with of operable, and affordable access to space. Evaluate of geometry scramjet flow path. Develop inlet system f enable fuller dominance of space. Design, fabricate, Quantify scramjet inlet mass capture and boundary la Develop high fidelity analytical tools to evaluate con generation aerospace vehicles and their weapons for maximize the use of vehicle speed in force miniaturize	her engine cycles such as rockets and gas turbine engine ptions to enable variable geometry scramjet technology for air-breathing space access vehicles requiring multiple and initiate wind tunnel testing of a sub-scale multiple ayer characteristics of each module resulting from multi- abined cycle engine options (e.g., gas turbine and ramje long-range strike. Identify key combined/combination ration and platform survivability for a capability beyon	es to enable responsive, reliable, . Initiate development of variable le scramjet engine modules to scramjet engine inlet system. -engine interactions. t/scramjet combinations) for next cycle engine technologies to d low observables. Conduct
	¢1.000	analyses to identify optimum transition Mach numbe speed of the ramjet/scramjet engine. Conduct pre-de sustainable flight Mach number achievable with selec	r between gas turbine engine and ramjet/scramjet engin sign study to evaluate force-multiplier and bomber surv ct gas turbine based combined/combination cycle engin	e cycles and the maximum cruise vivability as a function of maximum e options.
(U)	\$1,000	space. Determine optimum operating conditions to e fuel/additive combinations to improve ignition and a assess component operability and durability in small	erospace vehicle operational characteristics. Design an scale simulators.	, operable, and affordable access to Begin evaluation of advanced d fabricate subscale hardware to
(U)	\$1,000	Evaluate advanced high heat sink fuels and advanced Determine requirements for fuel/fuel additive combin and enable operation of advanced propulsion cycles. Initiate design and fabrication of reduced scale fuel s	I fuel cooling technology for next generation aerospace nations to improve component life and durability, impro Develop comprehensive test and qualification strategy ystem simulation components unique to next generation	vehicles for long range strike. ove fuel efficiency, reduce weight, for advanced high heat sink fuels. n bombers.
(U)	\$251	Demonstrate thermally stable fuels to enhance coolin high heat sink fuels to increase fuel delivery system of sub-scale integrated fuel/air heat exchanger.	g capacity (performance) and reduce fuel system maint durability at high temperatures and reduce maintenance	enance. Demonstrate advanced due to fuel degradation in a
(U)	\$402	Determine fuel cooling requirements for advanced ai unmanned aerospace systems. Determine properties and manned systems to sustain high altitude loiter for	rcraft sensors and directed energy weapons to meet the for low temperature additives to prevent fuel from free: r extended periods.	needs of evolving manned and zing and allow advanced unmanned
(U)	\$797	Develop low-cost fuel additives for Air Force application	ations. Evaluate and demonstrate optimum low-cost fue	el additive to reduce particulate
Р	roject 2480	Pag	e 5 of 22 Pages	Exhibit R-2A (PE 0603216F)

	RDT&E	BUDGET ITEM JUSTIFICATION S	HEET (R-2A Exhibit)	DATE February 2002
BUDG 03 -	GET ACTIVITY Advanced Tech	nology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Technology	PROJECT POwer 2480
(U)	A. Mission Descripti	on Continued		
(U)	FY 2002 (\$ in Thousa	nds) Continued emissions from gas turbine engines by 50 percent. Eva combustion in current and advanced and combined cvc	luate and demonstrate low-cost fuel additives to impr	ove ignition characteristics and
(U)	\$800	Develop fuel system technology. Design and develop f reusable aerospace vehicles. The focus will be on aeros cooling. Identify fuel concepts to maximize performan	uel system simulators to evaluate key high temperatu space vehicles with advanced and combined cycle engines and mini-	re fuel system components of gines that require high levels of fuel mize logistics costs
(U)	\$730	Identify and develop low-cost approaches to reducing the advanced additive packages to improve any commercial additives to improve fuels and advanced field diagnostic requirements, and aid in mission planning by monitoring	the fuel logistics footprint for the Expeditionary Air Fo lly available jet fuel to meet military standards. Deve c techniques such as smart nozzles to assess fuel qual g mission limiting fuel properties.	brce. Determine benefits of slop novel methods to inject ity, additive injection
(U)	\$12,380	Total		
(U)	FY 2003 (\$ in Thousa	unds)		
(U)	\$700	Demonstrate thermally stable fuels to enhance cooling of and demonstrate advanced high heat sink fuels that can due to fuel degradation in a sub-scale integrated fuel/air simulator.	capacity (performance) and reduce fuel system mainted increase fuel delivery system durability at high temper theat exchanger. Demonstrate long-term JP-8+225	enance. Continue to study, test, eratures and reduce maintenance performance in a fuel system
(U)	\$400	Continue determination of fuel cooling requirements for manned and unmanned aerospace systems. Develop re- advanced manned and unmanned systems to sustain hig Vehicle fuel system/tank simulator to study high and lo	r advanced aircraft sensors and directed energy weap quirements for low temperature additives to prevent f thatitude loiter for extended periods. Refine design w temperature fuel behavior	ons to meet the needs of evolving uel from freezing to allow and build Unmanned Aerial
(U)	\$800	Develop low-cost fuel additives for Air Force application particulate emissions from gas turbine engines by 50 per propulsion concepts including combined cycle engines.	bons. Continue performing demonstration testing with ercent and to improve ignition characteristics and com Demonstrate effectiveness of particulate mitigation	low-cost fuel additives to reduce bustion in current and advanced additives in a full-scale engine test.
(U)	\$400	Develop fuel system technology. Continue design and components of reusable aerospace vehicles. The focus high levels of fuel cooling. Continue investigation of fu	development of fuel system simulators to evaluate ke will be on aerospace vehicles with advanced and com- uel concepts to maximize performance of advanced or	y high temperature fuel system ibined cycle engines that require r combined cycle engines and
Р	roject 2480	Page 6	5 of 22 Pages	Exhibit R-2A (PE 0603216F)

	RDT&E BUDGET ITEM JUSTIFICATION S	SHEET (R-2A Exhibit)	DATE February 2002
BUDG 03 -	ET ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Technology	PROJECT 2480
(U)	A. Mission Description Continued		
(U)	FY 2003 (\$ in Thousands) Continued		
(U)	 minimize logistic costs. Complete characterization of \$875 Identify and develop low-cost approaches to reducing advanced additive packages to improve any commerci additives packages to improve fuels and advanced field requirements, and aid in mission planning by monitori identification and characterization. 	hydrocarbon fuel candidates for combined cycle engin the fuel logistics footprint for the Expeditionary Air Fo ally available jet fuel to meet military standards. Deve d diagnostic techniques such as smart nozzles to assess ng mission limiting fuel properties. Demonstrate field	es. orce. Determine benefits of lop novel methods to inject fuel quality, additive injection -capable concept for fuel
(U)	 \$4,500 Continue development of high fidelity analytical tools combinations, for next generation aerospace vehicles a (ramjet/scramjet) and combined cycle engine options f key engine technologies to maximize the use of vehicl low-observables. Continue to conduct analyses and ex and ramjet/scramjet engine cycles, and to optimize cru force-multiplier and bomber survivability as a function weapons. \$7,675 	to evaluate combined cycle engine options, such as ga and their weapons for long-range strike. Continue evalu- for next generation aerospace vehicles and their weapone e speed in force miniaturization and platform survivable operiments to optimize component technologies for tran- tise speed of ramjet/scramjet engines. Continue to com- n of flight Mach number achievable for next generation	s turbine and ramjet/scramjet nation of advanced ns for long-range strike. Develop ility for a capability beyond nsition between gas turbine engine duct pre-design study to evaluate n aerospace vehicles and their
(\mathbf{U})	B Project Change Summary		
(0)	Not Applicable.		
(U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602203F, Aerospace Propulsion. PE 0602102F, Materials. PE 0602204F, Aerospace Sensors. PE 0603112F, Advanced Materials for Weapons Systems. PE 0603253, Advanced Sensor Integration. This project has been coordinated through the Reliance process to harmonize	efforts and eliminate duplication.	
Р	roject 2480 Page	7 of 22 Pages	Exhibit R-2A (PE 0603216F)

	RDT&E BUDGET ITEM JUSTIFI	DATE Februai	y 2002		
BUD(03 ·	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Pro Technology	pulsion and	Power	PROJECT 2480
(U)	D. Acquisition Strategy Not Applicable.				
(U) (U)	E. Schedule Profile Not Applicable.				
F	Project 2480	Page 8 of 22 Pages		Exhibit R-2A (F	PE 0603216F)
		308			

	RDT	&E BUDGET ITEM JU	STIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDGET ACTIVITY 03 - Advanced Technology Development				PE NUMBE 060321 Techno	R AND TITLE 6F Aeros logy	space Pr	opulsion	and Pov	ver	PROJECT 3035	
	COST	(\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3035	Aerospace Pow	ver Technology	2,688	4,602	6,240	4,312	4,390	4,475	4,560	Continuing	TBD
(U)	A. Mission Description This project develops and demonstrates aircraft and ground power technology for engine starters, auxiliary power units, and electrical power generation and distribution systems. This technology enhances reliability and survivability; it reduces vulnerability, weight, and life cycle costs for (manned and unmanned) aircraft and spacecraft. The electric power system components developed are projected to provide a two to five times improvement in aircraft reliability and maintainability, and a 20 percent reduction in power system weight. This project also develops and demonstrates high power generation and storage technologies to enable high power density sources for directed energy weapons.										
(U) (U)	<u>FY 2001 (\$ in The</u> \$752	ousands) Designed, fabricated, and test survivability. Performed test reluctance starter generator w improvements over conventio	ed an electri ing of the de ith magnetic	cal distribut monstrator a bearings an	ion system v aircraft on-bo d the turbon	which ensure bard Integrat bachine to de	s fault tolera ed Power U emonstrate I	nt architectu nit (IPU). T PU feasibilit	rre, improvin he demonstr y, weight sa	ng aircraft re ator integrate vings, and re	liability and ed the switched liability
(U)	\$0	Design, fabricate, and test for	emergency	power capal	oilities of an	IPU. Applic	cations inclu	de rapid roto	or spin-up ar	d light-off, a	and continuous
(U)	 \$1,936 \$1,936 Developed power generation, conditioning, and distribution; energy storage; and thermal management component and subsystem technologies for manned and unmanned aircraft systems. Test IPU prognostics health management and power electronics for increased reliability, decrease maintenance, and two times increase in power density, which is enabling for advanced fighter aircraft and Uninhabited Combat Aerial Vehicles. Performed trade studies and requirements definitions for advanced motor drives applicable to fuel pumps and flight control 										
(U)	\$2,688	Total									
P	roject 3035			Page	9 of 22 Pag	es			Ex	hibit R-2A (PE ()603216E)

	RDT&	E BUDGET ITEM JUSTIFICATION S	HEET (R-2A Exhibit)	DATE February 2002	
BUDG 03 -	BET ACTIVITY Advanced Tech	nnology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Technology	PROJECT I Power 3035	
(U)	A. Mission Descript	ion Continued			
(U)	FY 2002 (\$ in Thous	ands)			
(U)	\$2,000	Develop high-density secondary power system and adv strike. Initiate trade studies, detailed design, and critica efficiency. Evaluate electric power technology options	anced weapons power technology for a next generation al technology development to optimize secondary power for advanced weapon systems.	on aerospace vehicle for long range ver system size, weight, and	
(U)	\$236	Develop cryogenic power generation, high rate batterie low volume displacement for delivery of high power to sufficient to fabricate coated conductors for cryogenic	es, energy storage and power conditioning components operate directed energy weapons. Fabricate lengths generators.	s, and system technologies with of Yttrium Barium Copper Oxide	
(U)	 \$777 Develop power generation, conditioning, and distribution; energy storage; and thermal management component and subsystem technologies for manned and unmanned aircraft systems. Demonstrate technologies for an integrated power unit for advanced fighter aircraft and unmanned vehicles. 				
(U)	\$1,589	Define requirements for high power generation systems superconducting and conventional generators for weap	s for directed energy weapons. Evaluate trade offs and ons power systems.	d define approaches for	
(U)	\$4,602	Total			
(U)	FY 2003 (\$ in Thous	ands)			
(U)	\$933	Develop power generation and conditioning; high rate high power subsystems with directed energy weapons. Continue to fabricate lengths of Yttrium Barium Coppe	batteries; and energy storage component and subsyste Develop high power low duty cycle generator for pu er Oxide sufficient to fabricate coated conductors for c	m technologies for integration of ilsed directed energy weapons. cryogenic generators.	
(U)	\$1,155	Develop power generation, conditioning, and distributi technologies for manned and unmanned aircraft system supportability while reducing life cycle costs and enabl propulsion system.	on component; energy storage; and thermal managem as. These technologies improve aircraft self-sufficienc ling new capabilities. Develop power generator system	ent component and subsystem y, reliability, maintainability, and m that is closely coupled with	
(U)	\$2,152	Develop power generation, conditioning and distribution that are synergistic with air, space, and weapons platfor lithium ion batteries that provide reductions in both vol	on; energy storage; and thermal management compone rms. Demonstrate advanced power conditioning techn ume and weight.	ent and subsystem technologies ologies with motor drives and	
(U)	\$2,000	Continue to develop and demonstrate high-density second aerospace vehicle for long-range strike. Conduct trade	ondary power system and advanced weapons power te studies, detailed design, and critical technology develo	chnology for a next generation opment to optimize secondary	
Р	roject 3035	Page 1	0 of 22 Pages	Exhibit R-2A (PE 0603216F)	

	RDT&E BUDGET ITEM JUSTIFICATION	SHEET (R-2A Exhibit)	DATE February 2002					
BUD(03 -	GET ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Technology	PROJECT 3035					
(U) (U) (U) (U)	A. Mission Description Continued EXECUTE: A state of the state	evaluation of electric power technology options for adv	anced weapon systems.					
(U) (U) (U) (U) (U) (U) (U)	 C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602203F, Aerospace Propulsion. PE 0602201F, Aerospace Flight Dynamics. PE 0602605F, Directed Energy Technology. PE 0603605F, Advanced Weapons Technology. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. 							
(U)	D. Acquisition Strategy Not Applicable.							
(U) (U)	E. Schedule Profile Not Applicable.							
Р	roject 3035 Page	11 of 22 Pages	Exhibit R-2A (PE 0603216F)					

RDT&E BUDGET ITEM J	USTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ıry 2002
BUDGET ACTIVITY 03 - Advanced Technology Development			PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Powe Technology				ver	PROJECT 4921	
COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4921 Aircraft Propulsion Subsystems Int	0	37,479	35,783	28,914	25,217	26,671	27,116	Continuing	TBD
Note: In FY 2002, all turbine engine technology efforts	erformed in F	E 0603202F	, Project 668	A, are trans	ferred into t	his project.			

(U) <u>A. Mission Description</u>

This project develops and demonstrates gas turbine propulsion system technologies applicable to aircraft. The 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. This project also focuses on system integration aspects of inlets, nozzles, engine/airframe compatibility, and low-observable technologies. Aerospace Propulsion Subsystems Integration (APSI) provides aircraft with potential for longer range and higher cruise speed 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. The APSI project 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 a ~30 percent reduction in tactical fighter aircraft takeoff gross weight and 100 percent increase in aircraft range/loiter. The IHPTET program provides continuous technology transition for military turbine engine upgrades and derivatives, and has the added dual-use benefit of enhancing the United States turbine engine industry's international competitiveness. Note: In FY 2002, Congress added \$2 million for Joint Expendable Turbine Engine Concept demonstrator engine.

- (U) <u>FY 2001 (\$ in Thousands)</u>
- (U) \$0 Previously accomplished in PE 0603202F, Project 668A.
- (U) \$0 Total

(U) <u>FY 2002 (\$ in Thousands)</u>

(U) \$5,778 Design, fabricate, and demonstrate durability and integration technologies for turbofan/turbojet engines. These technologies will improve durability, supportability, and affordability of current and future Air Force aircraft. Complete engine testing in support of the national High Cycle Fatigue program including forward swept fan blade damage tolerance, advanced instrumentation, model validation, and improved test protocol.

Project 4921	Page 12 of 22 Pages	Exhibit R-2A (PE 0603216F)	
	312		

	R	T&E BUDGET ITEM JUSTIFICATION	N SHEET (R-2A Exhibit)	DATE
BUD				
03 ·	- Advanced	Technology Development	0603216F Aerospace Propuls Technology	ion and Power 4921
(U)	<u>A. Mission De</u>	scription Continued		
(U)	FY 2002 (\$ in	Thousands) Continued		
(U)	\$20,100	Design, fabricate, and demonstrate advanced comp engines for fighters, bombers, and transports. Con Integrally Bladed Rotor (IBR) repair, fan rim damp pressure turbine, probabilistic rotor system design, hardware, and Ceramic Matrix Composite (CMC) forward swept fan, tiled LPT blade, uncooled CMC	ponent technologies for improved performance a nplete demonstrator engine test of fixed inlet gui per, High Cycle Fatigue (HCF) mistuning technol gamma titanium aluminide Low Pressure Turbi technologies. Continue advanced engine design C LPT blade, and model-based control with diag	nd fuel consumption of turbofan/turbojet ide vanes and Moderate Aspect Ratio rotor, ologies, vaneless counterrotating high/low ine (LPT) coverplate, sprayform cast ns for HCF robust front frame, two-stage mostics.
(U)	\$6,120	Design, fabricate, and demonstrate advanced comp durability, and affordability of engines for missile Composite (OMC) fan, high stage loading splittere Complete engine testing the high stage loading spl	bonent technologies for limited life engines. The and unmanned air vehicle applications. Complete a fan, uncooled ceramic high/low pressure turbitittered fan and uncooled ceramic low pressure tu	ese technologies improve performance, ete design and fabricate Organic Matrix ine, slinger and low volume combustors. urbine in a demonstrator engine.
(U)	\$3,500	Develop high speed turbine engine technology for turbine technologies for long range strike vehicles integrated design of turbine engine controls, exhau beyond low observables.	next generation aerospace vehicles for long rang (e.g., gas turbine and ramjet/scramjet combined ist nozzles, high temperature material componen	ge strike. Initiate study to evaluate gas /combination cycle engines). Initiate .ts, and mechanical systems for capability
(U)	\$1,981	Develop turbine engines that reduce fuel consumpt limited life unmanned vehicle turbine engines. Th demonstrator in the Integrated High Performance T materials and high pressure ratio technologies. Th cast cool vanes.	tion, increase thrust/airflow ratio, and reduce pro- is is the goal of the Joint Expendable Turbine En Furbine Engine Technology program. Perform c ese technologies include single crystal Lamilloy	oduction costs for supersonic expendable and ngine Concept demonstrator, an important lesign, fabrication, assembly, and test of blades and advanced thermal barrier coated
(U)	\$37,479	Total		
(U)	FY 2003 (\$ in	Thousands)		
(U)	\$6,177	Design, fabricate, and demonstrate durability and i durability, supportability, and affordability of curre guide vanes and Moderate Aspect Ratio rotor, IBR high/low pressure turbine, probabilistic rotor syste	ntegration technologies for turbofan/turbojet eng ent and future Air Force aircraft. Complete engi repair, fan rim damper, HCF mistuning and dar m design, gamma titanium aluminide LPT cover	gines. These technologies will improve ne structural durability testing of fixed inlet nping technologies, vaneless counter-rotating rplate, sprayform cast hardware, and CMC
F	Project 4921	Pa	age 13 of 22 Pages	Exhibit R-2A (PE 0603216F)
			313	

	RDT&E	BUDGET ITEM JUSTIFICATION	SHEET (R-2A Exhibit)	DATE February 2002
BUDG 03 -	BET ACTIVITY Advanced Tech	nology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Technology	PROJECT Power 4921
(U)	A. Mission Descripti	on Continued		
(U)	FY 2003 (\$ in Thousa	ands) Continued technologies.		
(U)	\$20,800	Design, fabricate, and test advanced component techn fighters, bombers, and transports. Complete advance frame, two-stage forward swept fan, tiled Low Pressu Matrix Composite shaft and model-based flexible con Matrix Composite (OMC) tip shroud, carbon counter technology innovations can be applied to a significan enhancements to future aircraft engines.	all ologies for improved performance and fuel consumption d engine designs and initiate fabrication of HCF robust re Turbine (LPT) blade, uncooled Ceramic Matrix Com- ntrol with diagnostics. Initiate advanced engine designs protating intershaft seal, and active augmenter screech c t part of the Air Force's engine inventory and offer pote	n of turbofan/turbojet engines for front frame, affordable OMC fan iposite (CMC) LPT blade, Metal for tandem fan with Organic ontrol. Each of these component ntially significant performance
(U)	\$5,306	Design, fabricate, and test advanced component techn affordability of engines for missile and unmanned air ceramic high pressure turbine, slinger combustor. Co testing of high stage loading splittered fan and uncoo	vehicle applications. Complete fabrication and conduct omplete fabrication of low volume combustor. Complete d ceramic low pressure turbine	prove performance, durability, and t testing on an OMC fan, uncooled e engine structural durability
(U)	\$3,500	Develop high speed turbine engine technology for ne turbine technologies for long-range strike vehicles (e. integrated design and initiate long lead hardware for t mechanical systems for capability beyond low-observ	xt generation aerospace vehicles for long-range strike. g., gas turbine and ramjet/scramjet combined/combinat urbine engine controls, exhaust nozzles, high temperaturables.	Complete study to evaluate gas ion cycle engines). Continue ire material components, and
(U)	\$35,783	Total		
(U)	<u>B. Project Change S</u> Not Applicable.	ummary		
(U) (U) (U) (U) (U) (U)	C. Other Program F Related Activities PE 0602201F, Aerosp PE 0602203F, Aerosp PE 0602122N, Aircra PE 0603210N, Aircra	unding Summary (\$ in Thousands) pace Flight Dynamics. pace Propulsion. ft Technology. ft Propulsion.		
P	roject 4921	Page	14 of 22 Pages	Exhibit R-2A (PE 0603216F)

RDT&E BUDGET ITEM JUS	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)				
BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propu Technology	ulsion and Power	PROJECT 4921		
 (U) <u>C. Other Program Funding Summary (\$ in Thousan</u> (U) PE 0603003A, Aviation Advanced Technology. (U) This project has been coordinated through the Reliance (U) <u>D. Acquisition Strategy</u> 	nds) e process to harmonize efforts and eliminate duplication				
 Not Applicable. (U) <u>E. Schedule Profile</u> (U) Not Applicable. 					
Project 4921	Page 15 of 22 Pages	Exhibit R-2A	(PE 0603216F)		

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)							DATE	Februa	iry 2002
BUDGET ACTIVITY PE NUMBER AND TITLE 03 - Advanced Technology Development 0603216F Aerospace Propulsion and Po Technology Technology						ver	PROJECT 4922		
COST (\$ in Thousands)	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost		
4922 Space & Missile Rocket Propulsion	0	30,607	1,464	1,507	1,553	1,617	1,664	Continuing	TBD
Note: In FY 2002, all rocket propulsion technology efforts	performed i	n PE 060330	02F. Projects	s 4373 and 6	340. are tran	sferred into	this project.	in order to a	lign projects

with the Air Force Research Laboratory organization. In FY 2003, only the space unique technology efforts in this project will be transferred to PE 0603500F, Project 5033, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) <u>A. Mission Description</u>

This project develops advanced and innovative low-cost rocket turbomachinery and components, low-cost space and missile launch propulsion system technologies, and demonstrates advanced propellants for launch and orbit transfer propulsion. Characteristics such as environmental acceptability, affordability, reliability, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. This project also develops chemical, electrical, and solar rocket propulsion system technologies for station keeping and on-orbit maneuvering applications. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion systems, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy propellants. Technological advances developed in this program will improve the performance of expendable systems' payload capabilities by ~20 percent and reduce the launch and operations and support costs by ~30 percent. Technology advances will also lead to seven-year increase in satellite on-orbit time, a 50 percent increase in satellite maneuvering capability, a 25 percent reduction in orbit transfer operational costs, and a 15 percent increase in satellite payload. The projects in this program are part of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program, a joint Department of Defense, National Aeronautics and Space Administration (NASA), and industry effort to focus rocket propulsion technology on national needs. Note: In FY 2002, Congress added \$4.4 million for the IHPRPT program.

(U) <u>FY 2001 (\$ in Thousands)</u>

- (U) \$0 Previously accomplished in PE 0603202F, Projects 4373 and 6340.
- (U) \$0 Total

Project 4922

Page 16 of 22 Pages

Exhibit R-2A (PE 0603216F)

	RDT	DATE February 2002				
BUD0 03 -	GET ACTIVITY • Advanced Te	chnology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion a Technology	PROJECT and Power 4922		
(U)	A. Mission Descri	ption Continued				
(U)	FY 2002 (\$ in Tho	usands)				
(U)	\$10,675	Develop propulsion technology for current and fu into advanced liquid test bed demonstrator. Comp Continue fabrication of oxygen turbopump for int preburner components for integration into an adva and begin fabrication of hardware.	ture space launch vehicles. Continue to develop turbou plete fabrication and assembly of combustion chamber egration into an advanced liquid booster engine. Comp anced liquid booster engine. Complete the design of ac	machinery components for integration and injector for liquid engine booster. plete testing of oxygen and hydrogen dvanced hydrocarbon test bed engine		
(U)	\$5,000	Conduct detailed design of hydrocarbon rocket en analyses to determine optimum operating condition component design to include turbopumps, boost p engine without causing coking or stability problem	igine test bed to enable responsive, reliable, operable, a ons and cooling requirements for hydrocarbon rocket er pumps, and thrust chambers. Demonstrate use of hydro ns.	and affordable access to space. Conduct ngine. Develop rocket engine test bed ocarbon fuels and additives to cool		
(U)	\$3,775	Develop propulsion technologies for current and f propulsion technologies, such as strut developmen to develop electric propulsion systems for orbit-tr earth orbit transfer.	future upper stage and orbit transfer vehicles. Continue nt, pointing, and tracking, for orbit transfer and maneuv ansfer by developing high-power Hall thrusters capable	e to demonstrate solar thermal vering propulsion. Continue program e of low-earth orbit-geosynchronous		
(U)	\$4,000	Develop technologies for the sustainment of strate technologies with readily available materials to re increase in service life for ballistic missiles. Begi advanced propellant, case, and pozzle technologie	egic systems. Continue the Post Boost Control System educe hardware costs, achieve a 90 percent reduction in n evaluating the Strategic Sustainment Demonstration	program to demonstrate component hydrazine leakage, and five times program hardware that integrates		
(U)	 U) \$2,800 Develop electric propulsion technologies for satellite formation flying, station keeping, and repositioning. Continue development of mathematical models to address different propulsion technologies that could be used for small satellite formation flying. Continue brass bo level testing of a pulsed plasma thruster. Continue development of propulsion systems for Air Force small satellites (<100 kg) required for Air Force Space Command concepts. Complete design of flight hardware and begin technology transition of selected propulsion concepts. 					
(U)	\$4,357	Continue to develop turbomachinery components fabrication and assembly of the combustion cham integration into an advanced liquid booster engine advanced liquid booster engine.	for integration into an advanced liquid propellant test ber and injector for a liquid engine booster. Continue e. Complete testing of oxygen and hydrogen preburner	bed demonstration. Complete fabrication of oxygen turbopump for components for integration into an		
Р	roject 4922	Р	age 17 of 22 Pages	Exhibit R-2A (PE 0603216F)		

	RDT&E BUDGET ITEM JUSTIFICATIC	N SHEET (R-2A Exhibit)	DATE February 2002
BUD 03	BET ACTIVITY • Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion an Technology	PROJECT nd Power 4922
(U)	A. Mission Description Continued		
(U) (U)	\$30,607 Total		
(U) (U)	FY 2003 (\$ in Thousands)\$1,464This project previously included space unique functivilian salaries for the work effort transferred and	nding which has been transferred to PE 0603500F, Projected will be transferred at a later date.	et 5033. These funds represent the
(U)	\$1,464 Total		
(U)	<u>B. Project Change Summary</u> Not Applicable.		
(U)	C. Other Program Funding Summary (\$ in Thousands)		
(U)	Related Activities:		
(U)	PE 0602102F, Materials. PE 0602601F, Spacecraft Technology.		
(U)	PE 0603401F, Advanced Spacecraft Technology.		
(U)	PE 0603853F, Evolved Expendable Launch Vehicle Program.		
(U)	PE 0603114N, Power Projection Advanced Technology.		
(\mathbf{U})	This project has been coordinated through the Reliance process to harmo	onize efforts and eliminate duplication.	
(U)	<u>D. Acquisition Strategy</u> Not Applicable.		
(U) (U)	E. Schedule Profile Not Applicable.		
	Project 4922	Page 18 of 22 Pages	Exhibit R-2A (PE 0603216F)

	RDT&I	E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUD(03 -	BUDGET ACTIVITY 03 - Advanced Technology Development				РЕ NUMBE 060321 Techno	R AND TITLE 6F Aeros logy	space Pr	opulsion	and Pov	ver	PROJECT 681B
COST (\$ in Thousands) FY 2001 Actual FY 2002 Estimate				FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost	
681B	Advanced Turbine	Engine Gas Generator	35,617	36,480	34,488	29,929	26,755	27,295	27,811	Continuing	TBD
(U)	(U) <u>A. Mission Description</u> This project develops turbine engine gas generator technology for current and future aircraft propulsion systems. The objective is to provide the continued evolution of technologies into an advanced gas generator in which the performance, cost, durability, reparability, and maintainability aspects can be assessed in a real engine environment. The gas generator, or core, is the basic building block of the engine and it consists of a compressor, a combustor, and a high pressure turbine. Experimental core engine testing enhances early, low-risk transition of key engine technologies into engineering development where they can be applied to derivative and/or new systems. These technologies are applicable to a wide range of military and commercial systems including aircraft, missiles, land combat vehicles, and ships. Component technologies are demonstrated in a core (sub-engine) test. Performance is subsequently proven in demonstrator engines under realistic conditions (Project 4921). Efforts are part of the Integrated High Performance Turbine Engine Technology (IHPTET) program. Note: In FY 2002, Congress added \$2 million vectored thrust ducted propellers.					nued evolution a real engine rbine. ed to derivative ehicles, and stic conditions led \$2 million for					
(U) (U)	FY 2001 (\$ in Thousands) \$27,035 Designed, fabricated, and performance tested technology demonstration core engines to provide improved performance and fuel consumption for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports. Completed core engine testing for integrally bladed rotor repair, impingement film floatwall combustor, advanced thermal barrier coating, supercooled high pressure turbine castability, and technologies to mitigate High Cycle Fatigue. Designed and fabricated long-lead hardware for core engine testing of load decoupler fan frame, ceramic matrix composite combustor liner, ceramic bearing, and advanced turbine vane, blade, and disk materials. All of these technologies are applicable to a significant part of the Air Force engine inventory along with future engines.										
	51,555 Designed, fabricated, and durability tested technology demonstration core engines to provide increased durability and affordability for turbofan/ turbojet engines for fighters, attack aircraft, bombers, and large transports. Conducted core engine testing of national High Cycle Fatigue program, compressor rotor ring damper, compressor rotor damping coating, and advanced non-intrusive stress measurement system.						High Cycle ment system.				
(U)	 J) \$4,181 Designed, fabricated, and tested 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 uninhabited air vehicles. Conducted core engine testing of splittered compressor rotor, rich quench lean combustor, counter rotating turbines, ceramic turbine vanes, and hybrid ceramic bearings. Fabricated hardware for core engine testing of forward swept splittered compressor rotor, high temperature rise 						n for turboshaft/ d air vehicles. rbine vanes, and rature rise				
Р	roject 681B			Page	19 of 22 Pag	ges			Ex	hibit R-2A (PE 0603216F)

	RD	DATE February 2	002		
BUD(03 -	GET ACTIVITY - Advanced	Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propu Technology	ulsion and Power	PROJECT 681B
(U)	A. Mission Des	scription Continued			
(U)	<u>FY 2001 (\$ in 7</u>	Thousands) Continued			
(U)	\$2,115	combustor, counter rotating vaneless turbine, cer- Designed, developed, and initiated testing on stru- hypersonic propulsion concepts in support of Det testing of flight type scramiet combustor and inle	amic matrix composite turbine blades and van actures and propulsion designs to demonstrate fense Advanced Research Projects Agency mi	es, and magnetic bearings. performance and durability of advance ssile demonstration. Performed fabrica	ed ation and
(U)	\$333	Evaluated novel vectored thrust propellers for tur	boprop/turboshaft engine concepts for application	tion to helicopters for combat rescue.	
(U)	\$35,617	Total			
(U)	FY 2002 (\$ in 7	Chousands)			
(U)	\$29,080	turbofan/turbojet engines for fighters, attack aircu core engine testing of load decoupler fan frame, o and disk materials. Design advanced hardware f control, integrated lightweight combustor with ce and an endothermic fuel/air heat exchanger.	raft, bombers, and large transports. Complete ceramic matrix composite combustor liner, cer for core engine testing of a high pressure ratio eramic matrix composite panels, a microplasm	design and continue fabrication of har- ramic bearing, and advanced turbine va four stage compressor with stability er a ignitor, revolutionary turbine blade r	dware for ane, blade, nhancing material,
(U)	\$2,270	engines for fighters, attack aircraft, bombers, and national durability program.	l large transports. Design turbine engine adva	nced hardware for core engine evaluati	ion in the
(U)	\$3,149	Design, fabricate, and evaluate technology demo- turboprop and small turbofan engines for trainers Continue evaluation of core engine forward swep turbine, ceramic matrix composite turbine blades	nstration core engines to provide improved pe s, rotorcraft, special operations aircraft, theater of splittered compressor rotor, high temperatur and vanes, and magnetic bearings.	rformance and fuel consumption for tu transports, and large unmanned air ve e rise combustor, counter rotating vane	ırboshaft/ hicles. eless
(U)	\$1,981	Develop turboprop/turboshaft engine technologie	es that are applicable to military helicopter app	lications such as combat search and re	escue.
(U)	\$36,480	Total			
F	Project 681B]	Page 20 of 22 Pages	Exhibit R-2A (PE 0	603216F)
			320 JNCLASSIFIED		

	RDT&B	E BUDGET ITEM JUSTIFICATION S	SHEET (R-2A Exhibit)	DATE February 2002					
BUDC 03 -	GET ACTIVITY - Advanced Tech	nology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Technology	PROJECT 681B					
(U)	A. Mission Descript	on Continued							
(U) (U)	FY 2003 (\$ in Thousands)\$28,826Design, fabricate, and performance test technology demonstration core engines to provide improved performance and fuel consumption for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports. Complete design and continue hardware fabrication of a core engine test article with a load decoupler fan frame, a trapped vortex combustor, ceramic matrix composite combustor liner, ceramic bearing, advanced turbine blisk and advanced turbine vane materials. Complete design and continue fabrication of hardware for core engine testing of a high pressure ratio four stage compressor with integrated lightweight combustor with ceramic matrix composite panels, microcircuit cooling, revolutionary hot section material, and an endothermic fuel/air heat exchanger. Each of these technology innovations can be applied to a significant part of the Air Force's engine inventory and offer potentially significant performance enhancements to future aircraft engines								
(U)	\$2,024	Design, fabricate, and durability test technology demon turbofan/turbojet engines for fighters, attack aircraft, b hardware for turbine engine advanced hardware for con	nstration core engines to provide increased durability a ombers, and large transports. Continue design and ini- re engine evaluation in the national durability program	and affordability for tiate fabrication of long lead					
(U)	\$3,638	Design, fabricate, and evaluate technology demonstrati turboshaft/turboprop and small turbofan engines for tra vehicles. Complete core engine testing of forward swe vaneless turbine, ceramic matrix composite turbine bla	ion core engines to provide improved performance and inners, rotorcraft, special operations aircraft, theater tra ept splittered compressor rotor, high temperature rise c des and vanes, and magnetic bearings.	I fuel consumption for insports, and large uninhabited air combustor, counter rotating					
(U)	\$34,488	Total							
(U)	<u>B. Project Change S</u> Not Applicable.	ummary							
(U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program F Related Activities: PE 0602201F, Aerosp PE 0602203F, Aerosp PE 0602122N, Aircra PE 0603210N, Aircra PE 0603003A, Aviati This project has been	unding Summary (\$ in Thousands) pace Flight Dynamics. pace Propulsion. ft Technology. ft Propulsion. on Advanced Technology. coordinated through the Reliance process to harmonize of the second secon	efforts and eliminate duplication.						
P	Project 681B	Page 2	21 of 22 Pages	Exhibit R-2A (PE 0603216F)					

BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT 06/03/216F Aerospace Propulsion and Power 681B Technology Technology 681B (I) D.Acquisition Strategy Not Applicable. Not Applicable. 7 (II) E.Schedule Profile 7 7 (II) Not Applicable. 7 7		RDT&E BUDGET ITEM JUSTIFIC	DATE Febru	February 2002	
(1) D. Acquisition Strategy Not Applicable. (1) E. Schedule Profile (1) Not Applicable.	BUD 03	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion Technology	and Power	PROJECT 681B
(U) E. Schedule Profile (U) Not Applicable. Project 681B Page 22 of 22 Pages Exhibit R-2A (PE 0603216F)	(U)	D. Acquisition Strategy Not Applicable.			
Project 681B Page 22 of 22 Pages Exhibit R-2A (PE 0603216F)	(U) (U)	<u>E. Schedule Profile</u> Not Applicable.			
Project 681B Page 22 of 22 Pages Exhibit R-2A (PE 0603216F)					
Project 681B Page 22 of 22 Pages Exhibit R-2A (PE 0603216F)					
Project 681B Page 22 of 22 Pages Exhibit R-2A (PE 0603216F)					
Project 681B Page 22 of 22 Pages Exhibit R-2A (PE 0603216F)					
Project 681B Page 22 of 22 Pages Exhibit R-2A (PE 0603216F)					
Project 681B Page 22 of 22 Pages Exhibit R-2A (PE 0603216F)					
Project 681B Page 22 of 22 Pages Exhibit R-2A (PE 0603216F)					
Project 681BPage 22 of 22 PagesExhibit R-2A (PE 0603216F)					
	F	Project 681B	Page 22 of 22 Pages	Exhibit R-2A	(PE 0603216F)

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								ATE February 2002	
BUDGET ACTIVITY 03 - Advanced Technology Development			PE NUMBER AND TITLE PROJE 0603227F Personnel Training and Simulation 2743 Technology PROJE					PROJECT 2743		
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2743	Advanced Training/Force Management	6,171	0	0	0	0	0	0	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: In FY 2002, efforts transfer to PE 0603231F, Project 4924, to align resources with the Air Force Research Laboratory organization.

(U) <u>A. Mission Description</u>

This program develops and demonstrates technologies that will result in improved warfighter readiness. Develops, demonstrates, and evaluates technologies for Distributed Mission Training (DMT) including realistic, effective, and affordable synthetic combat environments, technologies for long distance networking to enhance joint-Service training, visual displays for real-time and post-mission debrief, and instructional strategies to support warfighter training in a joint synthetic battlespace. Provides a technology testbed for examining warfighter skills, cognitive functions, and behaviors contributing to combat readiness. Develops models to support aircrew, space, and information operations, performance measurement systems for air, space, and information warfare, and tools for mission planning, rehearsal, execution, and force protection in a distributed mission environment. Develops and demonstrates technology jobs, and software to enable Air Force training developers to rapidly and affordably build intelligent computer-assisted training systems which continually interact with students for effective individualized training. Develops and demonstrates information management technology for the warfighter at the unit level. Work concentrates on aircrew, space, and information dominance domains.

(U) <u>FY 2001 (\$ in Thousands)</u>

(U) \$713	Developed and demonstrated integrated techniques for DMT for aerospace operations, force protection	n, and command and control personnel to
	reduce the learning time for new operators, sustain critical mission competencies, and ensure that depl	oyed personnel have the knowledge and
	skills to support the mission. Completed first training transfer studies of the impact of DMT on Air Fo	orce air-to-air combat flying performance,
	and demonstrated impact of DMT on washback rates and quality of performance during Flight Lead U	pgrade training. Completed
	identification and representation of mission essential competencies for aerospace and information oper	rators and force protectors. Developed
	and field tested a common satellite architecture for control training in aerospace operations center, and	l integrated team performance
	measurement methods to assess the readiness and mission impact of DMT for combat support teams.	
(U) \$1,294	Developed advanced distributed learning information systems technologies that increase mission rehea	arsal capability for the warfighter by
Project 2743	Page 1 of 4 Pages	Exhibit R-2 (PE 0603227F)

	RD	I&E BUDGET ITEM JUSTIFICATION	SHFFT (R-2 Exhibit)	DATE Eobruary 2002
03 -	• Advanced Te	echnology Development	0603227F Personnel Training and Si	imulation 2743
			Technology	
(U)	A. Mission Desci	iption Continued		
(U)	<u>FY 2001 (\$ in Th</u>	ousands) Continued		
(U)	\$1.761	creating the ability to import real-time intelligence data warfighter with enhanced training tools to make accura under the mandated High Level Architecture (HLA) stu disbursed man-in-the-loop simulators operating under using real-time intelligence information. Demonstrated advances in simulator visual system tech	a into the Distributed Mission Training (DMT) enviro- te and timely decisions in a real-time environment. In ructure and continued evaluation of a multi-level secu different security classification levels. Demonstrated	nment. Technologies provide the nfused real-time intelligence data rity system for geographically and evaluated pilot training results age generation, display, and
(0)	¢1,101	database systems. Advanced visual systems provide of bridges at realistic tactical ranges or to properly assess development of PC-based high resolution real-time ima- laser projector for DMT simulators. Continued develo- simulator.	perators greater visual definition to identify other airci- their aspect angle, increasing mission rehearsal capab age generator and development tools. Advanced deve pment and integration of a less expensive, optical infi	caft, ground vehicles, roads, and ility for the warfighter. Continued lopment of an ultra-high resolution nity display material for the
(U)	\$998	Advanced DMT capabilities by increasing functional fractional fraction technologies. These advances mission rehearsal capability for the warfighter as they a environment representations that can be updated with r models and their interaction with the environment. De scalable training activities. Developed and tested image encoding of source imagery versus current hand coding	idelity and realism of the training system through dem s in computer models of enemy threats, terrain, weather acquire more accurate responses to battlefield stimuli. real-time intelligence data. Developed physics-based is veloped an HLA compliant simulation architecture op gery manipulation tools for automatic database generator.	onstrating and evaluating er, and human behavior increase Developed threat models and radar threat, and other sensor otimized for real-time, distributed, tion including automatic materials
(U)	\$1,405	Developed and demonstrated technologies for high fide preview, and rehearsal capabilities. This reduces the co pretraining prior to aircraft, and increases combat train Evaluated measures of training effectiveness, mission p evaluation of NVG training techniques to include dista	elity Night Vision Goggle (NVG) simulation to suppo ost of initial NVG qualification, allows for effective a ing realism by adding simulated weather, seasonal, an performance, and transfer of training from simulator to nce estimation for aircraft, formation and aerial refuel	rt and increase mission training, dvanced night operation mission d environmental changes. o the aircraft. Conducted field ling, and combat maneuvering.
(U)	\$6,171	Total		
P	roject 2743	Page	2 of 4 Pages	Exhibit R-2 (PE 0603227F)
			324	

	RDT&E BUDGET ITEM JUSTIFICATION	DATE Febru	February 2002		
BUD 03	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603227F Personnel Technology	Training and S	Simulation	PROJECT 2743
(U)	A. Mission Description Continued				
(U) (U) (U)	FY 2002 (\$ in Thousands)\$0Effort moved to PE 0603231F, Project 4924.\$0Total				
(U) (U) (U)	FY 2003 (\$ in Thousands)\$0No Activity\$0Total				
(U)	<u>B. Budget Activity Justification</u> This program is in Budget Activity 3, Advanced Technology Development military utility and address warfighter needs.	, since it develops and demonstra	tes technologies for ne	ew system develop	ments that have
(U)	<u>C. Program Change Summary (\$ in Thousands)</u>				
(U) (U) (U) (U) (U) (U)	Previous President's Budget Appropriated Value Adjustments to Appropriated Value a. Congressional/General Reductions b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram e. Rescissions Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR Significant Program Changes:	<u>FY 2001</u> 6,432 6,491 -152 -109 -59 6,171	<u>FY 2002</u> 0 0	<u>FY 2003</u> 0	<u>Total Cost</u> TBD TBD
F	In FY 2002, efforts transfer to PE 0603231F, Project 4924, to align resource Project 2743 Pa	es with the Air Force Research L ge 3 of 4 Pages	aboratory organization	n. Exhibit R-2	(PE 0603227F)
		325			

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE February 2002
BUD0 03 -	BET ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603227F Personnel Training and S Technology	PROJECT imulation 2743
(U) (U) (U) (U) (U)	D. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602202F, Human Effectiveness Applied Research. PE 0604227F, Distributed Mission Training (DMT). This project has been coordinated through the Reliance process to harmonize	efforts and eliminate duplication.	
(U)	<u>E. Acquisition Strategy</u> Not Applicable.		
(U) (U)	F. Schedule Profile Not Applicable.		
P	roject 2743 Pag	e 4 of 4 Pages	Exhibit R-2 (PE 0603227F)
326			
PE TITLE: Crew Systems and Personnel Protection Technology

	RDT&E BUDGET ITEM J	DATE	DATE February 2002								
BUDGE ⁻ 03 - A	T ACTIVITY		PE NUMBE 060323 ⁷ Technc	R AND TITLE 1F Crew blogy	Systems	s and Per	sonnel l	el Protection			
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost	
	Total Program Element (PE) Cost	17,088	34,023	29,690	35,193	34,490	33,559	34,196	Continuing	TBD	
2830	Decision Support and Cognitive Systems	5,500	7,435	6,238	7,695	7,008	6,434	6,387	Continuing	TBD	
3257	Helmet-Mounted Sensory Technologies	11,588	9,534	5,938	6,124	5,398	5,497	5,595	Continuing	TBD	
4923	Logistics Readiness and Sustainment	0	10,324	7,341	11,806	10,750	11,192	11,565	Continuing	TBD	
4924	Distributed Mission Training Technology	0	6,730	7,532	6,664	7,369	7,387	7,392	Continuing	TBD	
5020	Directed Energy Protective Systems	0	0	2,641	2,904	3,965	3,049	3,257	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	

Note: In FY 2002, all activity previously reported in PE 0603106F will be reported in Project 4923 and all activity previously reported in PE 0603227F will be reported in Project 4924. In FY 2003, the Directed Energy Protective Systems program at Brooks AFB will move from Project 3257 to Project 5020 to align resources with the Air Force Research Laboratory organization.

(U) <u>A. Mission Description</u>

This program develops and demonstrates technologies to enhance human performance and effectiveness and 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

Page 1 of 18 Pages

Exhibit R-2 (PE 0603231F)

	RDT&E BUDGET ITEM JUSTIFIC	DATE Febru	DATE February 2002		
BUDO 03 -	BET ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Sys Technology	stems and Per	sonnel Protectio	on
(U)	<u>A. Mission Description Continued</u> systems. The Distributed Mission Training Technology project Directed Energy Protective Technologies project develops and d involved with test, deployment, and operation of high-energy las Testbed and \$1.0 million for Head-Mounted Technology.	develops and demonstrates advanced train lemonstrates advanced technologies for lasser weapons. Note: In FY 2002, Congress	ing, simulation, and ser eye protection an s added \$1.0 million	mission rehearsal tech ad for assuring safety o for Combat Automatio	nologies. The f personnel on Requirements
(U)	<u>B. Budget Activity Justification</u> This program is in Budget Activity 3, Advanced Technology De Air Force personnel in operational environments.	evelopment, since it develops and demonst	rates technologies to	p protect and enhance t	he performance of
(U)	C. Program Change Summary (\$ in Thousands)				
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	Total Cost
(U) (U)	Previous President's Budget	17,319	32,356	34,775	TBD
(U) (U)	Appropriated Value	17,479	34,356		
(0)	Aujustinents to Appropriated value		333		
	h Small Business Innovative Research	-410	-555		
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram	179			
	e. Rescissions	-160			
(U)	Adjustments to Budget Years Since FY 2002 PBR			-5,085	
(U)	Current Budget Submit/FY 2003 PBR	17,088	34,023	29,690	TBD
(U)	Significant Program Changes: Decrease in FY 2003 is to fund other priority Science and Techn	nology programs.			
		Page 2 of 18 Pages		Exhibit R-2	(PE 0603231F)
		209			(

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE	DATE February 2002	
BUDG 03 -	JDGET ACTIVITY PE NUMBER AND TITLE 3 - Advanced Technology Development 0603231F Crew Systems and Personne Technology Technology								rsonnel f	Protectio	PROJECT n 2830
	COST (\$	\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2830	Decision Support	t and Cognitive Systems	5,500	7,435	6,238	7,695	7,008	6,434	6,387	Continuing	TBD
(U)	A. Mission Description This project provides technology to improve human combat performance, combat support performance, and aerospace safety through better information delivery and crew station integration, which are achievable through effective decision support and cognitive systems engineering. Crew stations represent the fundamental interface between the warfighter and equipment across the gamut of aerospace operations. To cope with the recognized data overload in command centers and weapon platforms, this project develops technologies to quantify requirements, develop information interfaces, and evaluate crew performance in selected operational environments. This project includes bioacoustic technologies to complement decision support and visual information technologies as part of an integrated solution to negate information overload in the Air Expeditionary Force environment, while improving sound cueing, voice communications, and hearing protection for weapon systems operators, command centers, and security forces. Note: In FY 2002, Congress added \$1.0 million for Combat Automation Requirements Testbed.										
(U) (U)	<u>FY 2001 (\$ in Thou</u> \$1,844	 <u>isands</u>) Developed and demonstrated time for system developers to in design. Completed develo Architecture. Completed a fu objective. performance-basec 	human mod isolate and pment of sin inctional spe crew system	eling techno analyze criti nulation soft crification fo m requireme	logies and si cal operator ware and de or using the r	imulation too tactics in sin monstrated i nodeling tec	ols to verify mulated oper integration w hnology in a	crew perforn rational exer vith human c a simulation-	mance requin cises, and su perator mod based testbe	rements, redu ipported clea lels using the ed that suppo	uce the cost and r accountability High-Level rted establishing
(U)	\$2,950	Developed and demonstrated Demonstrated life support tec and fatalities for crewmembe developing head, neck, and e	subsystems hnologies tc rs, regardles ye protection	to protect th address spe s of gender, n for HMD t	e aircrew me cific deficie ejecting at h echnology d	ember during ncies observ digher airspe- uring high-s	g combat and red in recent eds while we peed escape	d emergency combat oper earing Helme to 600 Knot	operations rations. Dec et-Mounted s Equivalent	in current an creased risk c Devices (HM t Air Speed t	d future aircraft. of major injuries ID) by hreshold.
(U)	 \$706 Developed and demonstrated advanced, user-tailored information management and portrayal technologies that enhance battlespace situational awareness for global-level and MAJCOM-level information operations centers to reduce decision-making bottlenecks. Continued to develop user-tailored visualizations promoting battlespace situational awareness. Demonstrated the capability for effective, time-critical information exchange operations between MAJCOM Network Operations and Security Centers. 										
(U) P	\$5,500 Project 2830	Total		Page	• 3 of 18 Pag	100			F۱	xhihit R-2A	(PE 0603231E)

	RDT&I	DATE February 2002						
BUDC 03 -	GET ACTIVITY • Advanced Tech	nnology Development	PE NUMBER AND TITLE 0603231F Crew Systems and Person Technology	PROJECT Inel Protection 2830				
(U)	A. Mission Descript	ion Continued						
(U)	FY 2002 (\$ in Thous	ands)						
(U)	\$1,247	Develop and demonstrate human modeling technologie time for system developers to isolate and analyze critic design. Complete feasibility demonstration for integrat performance-based crew system requirements. Develop assessments of crew system concepts to quantify impac modeling teamwork, intra-team communications, and a	s and simulation tools to verify crew performance rec al operator tactics in simulated operational exercises, ing human modeling technology in a simulation-base plan to extend human modeling and simulation techn t on performance, mission effectiveness, and affordal ir center operations in support of effectiveness trades	quirements, reduce the cost and and support clear accountability in ed testbed to establish nologies to make effective trade-off bility. Demonstrate feasibility of used during acquisition.				
(U)) \$3,466 Develop and demonstrate aircrew escape subsystems to protect the aircrew member during emergency ejection in current and future high-performance fighter aircraft. Develop head/neck protection systems and Helmet-Mounted Devices (HMDs) that will provide a decrease in head and neck injuries for crewmembers wearing HMDs during high-speed emergency ejections. Conduct windblast testing to verify head, neck and eve protection are provided to 600 Knots Equivalent Air Speed							
(U)	\$990	Develop and demonstrate user-tailored information mar global-level and MAJCOM-level information operation visualizations promoting battlespace situational awaren execution, and combat assessment within the informati- step in developing a tool to support understanding of ac- in joint or Air Force specific exercises.	hagement and portrayal technologies that enhance bat as centers to reduce decision-making bottlenecks. Co- ess. Develop and demonstrate tools to improve infor on warfare flights of the numbered air forces. Perform liversarial decision-making. Demonstrate the effective	ttlespace situational awareness for ntinue to develop user-tailored mation operations planning, m cross-cultural analysis as a first eness of combat assessment tools				
(U)	\$742	Develop high performance bioacoustic hearing protecti around aircraft. Demonstrate improved noise attenuati earplug technology to achieve 35-40 dB field attenuation	on technologies to achieve 40-45 dB noise attenuation on performance metrics in laboratory and field enviro	n for personnel working in and onments. Integrate deep insert				
(U)	\$990	Develop and demonstrate technologies to enhance secu Demonstrate that using an eight microphone array can sound localization, and provide a limited remote detect tracking, and detecting threats. Begin to develop an inf awareness by using intelligent algorithms, 3-D audio, a	rity force situational awareness and threat response ti ncrease signal to noise ratio for a given look angle, p ion capability for security forces. Develop and evaluator formation management concept for deployed security nd audio symbology to code the detected threats and	me using acoustic sensors. rovide three-dimensional (3-D) ate acoustic algorithms for locating, forces to improve situational assist in threat intervention.				
(U)	\$7,435	Total						
Р	roject 2830	Page 4	of 18 Pages	Exhibit R-2A (PE 0603231F)				

	RDT&	DATE February 2002		
BUD 03	GET ACTIVITY - Advanced Tecl	hnology Development	PE NUMBER AND TITLE 0603231F Crew Systems and Person Technology	PROJECT Inel Protection 2830
(U)	A. Mission Descript	tion Continued		
(U) (U)	<u>FY 2003 (\$ in Thous</u> \$651	ands) Develop and demonstrate human modeling technolog time for system developers to isolate and analyze crit alternatives. Continue to extend human modeling an mission effectiveness. Begin to analyze and develop	gies and simulation tools to justify crew performance re tical operator tactics in simulated operational exercises, d simulation technologies to make effective trade offs b integrated crew system concepts to reduce manning wi	quirements, reduce the cost and and support analysis of between crew system concepts and thin air operations centers, showing
(U)	\$2,761	contribution of human modeling to substantiate time- Develop and demonstrate user-tailored information m global- and MAJCOM-level information warfare and integrate initial version of combat assessment tools in decision-making process and model to characterize d influenced by allied force actions. Develop speech m management tool. Improve flow of time-critical targ	-critical targeting effectiveness and affordability. nanagement and portrayal technologies that enhance ba l aerospace operations centers to reduce decision-makin nto joint and/or Air Force weapon systems. Develop ef- lifferent types of adversary systems and assess alternative ecognition front-end and advanced visualization for oper- geting information into strike aircraft to enhance pilot site chapted and advanced visualization for oper-	ttlespace situational awareness for g bottlenecks. Transition and fects-based adversarial we ways they may be favorably erations centers' information cuational awareness, exploiting
(U)	\$910	Develop advanced high performance bioacoustic hea and around fighter aircraft, with a long-term goal of a deep insert earplug technology with active noise redu	uring protection systems to achieve 40-45 dB noise atten 50 dB protection. Demonstrate communication capabili- action to achieve 45 dB field attenuation. Demonstrate	uation for personnel working in ity in 150 dB noise fields. Integrate improved attenuation and user
(U)	\$1,000	Develop and demonstrate advanced technologies to e sensors. Demonstrate to deployed security forces an intelligent algorithms, three-dimensional (3-D) audic Demonstrate at a military exercise the operational pa develop an automated threat assessment system using noise.	enhance security force situational awareness and threat n information management concept that can improve situ b, and audio symbology to code the detected threats and yoff from using 3-D audio radios and helmets in a mob- g neural networks and a sound library to evaluate the se	response time using acoustic national awareness by using assist in threat intervention. ile patrol squadron. Begin to verity and importance of detected
(U)	\$916	Develop and demonstrate human-centered science ar Information in Warfare and Information Warfare nee support systems, guidelines for effective selection of schedules to increase personnel efficiency and effect	nd technology for the Air Force Information Operations eds. This research will provide the information operatio information warriors, IO simulators and training system iveness, enhanced decision-making tools, and automate	(IO) community addressing ns warrior with tailored decision ns, improved operational shift d tools to reduce operator task load.
F	Project 2830	Pag	e 5 of 18 Pages	Exhibit R-2A (PE 0603231F)

	RDT&E BUDGET ITEM JUSTIFICAT	DATE February 2002	
вирс 03 -	BET ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems an Technology	PROJECT d Personnel Protection 2830
(U) (U) (U)	A. Mission Description Continued FY 2003 (\$ in Thousands) Continued Tools will be developed to influence human so develop adversary cultural and decision mode tools in support of intelligence and information \$6,238	enses to enable perception management and decepels, and improve interaction and monitoring capabion warfare units.	otion, model and simulate human behavior, ility by determining effectiveness of automated
(U) (U) (U) (U) (U) (U)	 B. Project Change Summary Not Applicable. C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602202F, Human Effectiveness Applied Research. PE 0604706F, Life Support Systems. This project has been coordinated through the Reliance process to has 	rmonize efforts and eliminate duplication.	
(U) (U) (U)	 D. Acquisition Strategy Not Applicable. E. Schedule Profile Not Applicable. 		
Ρ	roject 2830	Page 6 of 18 Pages	Exhibit R-2A (PE 0603231F)

	RDT&I	E BUDGET ITEM JU	STIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUD0 03 -	GET ACTIVITY • Advanced Tech	nnology Development			^{РЕ NUMBE 060323 Techno}	R AND TITLE	Systems	s and Pe	rsonnel F	Protectio	PROJECT 1 3257
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3257	Helmet-Mounted S	ensory Technologies	11,588	9,534	5,938	6,124	5,398	5,497	5,595	Continuing	TBD
Note Rese	: In FY 2003, the Dire arch Laboratory organ	ected Energy Protective Systems ization.	s program at	Brooks AF	B will move	from Projec	t 3257 to Pro	bject 5020 to	align resou	rces with the	Air Force
(U)	U) A. Mission Description This project develops and demonstrates advanced technologies for ejection-safe multi-functional helmet-mounted displays (HMD), and night vision devices. Helmet-mounted tracker and display (HMT/D) technologies development will enable pilots to detect, identify, target, and launch weapons faster and more accurately. Development of improved aircrew night vision goggles (NVG) technologies will enhance aerial combat capabilities at night. Note: In FY 2002, Congress added \$1.0 million for Head-Mounted Technology.										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$7,758	ands) Developed and demonstrated during day and night missions and demonstrated a miniature Continued to develop and dem source and an inertial head-m	advanced H s in all-weath flat display nonstrate a h ounted track	MT/D and s her condition to replace c high-luminar ter.	ubsystem teo ns. Develope athode ray tu nce, high-res	chnologies to ed and demo ibes in HMT olution, low	o improve m nstrated the C/Ds. Integra -voltage Act	ission effect utility of col ated a HMT ive Matrix (iveness and or symbolog /D into the a Drganic Ligh	pilot situatio gy on HMT/I iir-to-ground it Emitting D	nal awareness). Integrated strike mission. viode image
(U)	\$2,565	Developed and demonstrated technologies for improved aircrew NVG to increase mission effectiveness and enhance air operations by allowing the pilot to perform daytime tactics at night. Continued to develop miniature image sources and smaller format filmless image intensifier tubes to provide aircrew members a wider field-of-view, improved low-light level resolution, and reduced halo. Integrated and evaluated laser eye protection (LEP) technologies with paperamic night vision goggles (PNVG). Integrated imagery inaction on PNVC for flight test									
(U)	5) \$1,265 Developed and demonstrated technologies that counter the laser threat, and permit the deployment and use of high-energy laser weapons. Continued to evaluate the biological effects of laser weapons and high-energy laser systems. Initiated aircrew evaluation of dye and dielectric stack technologies for infrared and visible laser eye protection. Conducted optical and performance evaluations, and began aircrew evaluations of airborne laser, and vision corrective LEP spectacles. Delivered Laser Range Safety Tool to missile test ranges to support flight testing of Airborne Laser and other high-energy laser systems.										
(U)	\$11,588	Total							_		
l P	roject 3257			Page	7 of 18 Pag	es			Ex	hibit R-2A (PE 0603231F)

	RDT&	DATE February 2002					
BUD(03 ·	GET ACTIVITY - Advanced Tecl	nnology Development	PE NUMBER AND TITLE 0603231F Crew Systems and Person Technology	PROJECT nel Protection 3257			
(U)	A. Mission Descript	ion Continued					
(U) (U)	<u>FY 2002 (\$ in Thous</u> \$4,586	ands) Develop and demonstrate advanced helmet-mounted tr effectiveness and pilot situational awareness during da video insertion on HMT/D for air-to-ground strike mis Develop and demonstrate high-brightness, high resolut on future daytime HMT/Ds.	acker and display (HMT/D) and subsystem technolog y and night missions in all-weather conditions. Demo sions. Demonstrate inertial head tracker on HMT/D f ion, miniature flat panel display and assess utility as a	ies to improve mission nstrate advanced symbology and or air-to-ground strike missions. a replacement for cathode ray tube			
(U)	J) \$2,104 Develop and demonstrate technologies for improved aircrew night vision goggles to increase mission effectiveness and enhance air operations by allowing the pilot to perform daytime tactics at night. Demonstrate miniature image sources and smaller format filmless image intensifier tubes to provide aircrew members a wider field-of-view, improved low-light level resolution, and reduced halo effects. Demonstrate Integrated Panoramic Night Vision Goggles (IPNVG) technologies integrated with laser eye protection (LEP) technologies. Continue flight evaluation of IPNVG and demonstrate imagery insertion in flight						
(U)	\$2,844	Develop and demonstrate technologies that counter the of high-energy laser weapons. Continue evaluation of aircrew evaluation of dye/dielectric stack combination airborne LEP of dielectric stack-based technologies, ar technology for visible wavelength protection. Continue reflective LEP compared to combined dye/dielectric st	e multiple wavelength and agile laser threat and permit the biological effects of non-lethal laser weapons and LEP. Complete performance evaluation of vision-con ad begin aircrew evaluations of these devices. Demon e assessment of laser glare effects on visual performan- ack technologies.	t safe testing, deployment, and use high-energy laser systems. Finish rective prescription capability and strate next generation rugate nce of human subjects wearing			
(U)	\$9,534	Total					
(U) (U)	<u>FY 2003 (\$ in Thous</u> \$2,947	ands) Develop and demonstrate advanced HMT/D and subsy during day and night missions in all-weather condition and more accurately. Investigate and develop advance awareness, and reduce spatial disorientation. Integrate Investigate utility of advanced daytime HMT/D incom	stem technologies to improve mission effectiveness and s. These technologies help pilots to detect, identify, ta ed symbology sets for tactical HMT/Ds to improve tar ultra-sonic transducers with inertial head tracker to in orating miniature color display for future simulations	nd pilot situational awareness rget, and launch weapons faster geting, increase situational nprove tracker accuracy. and flight evaluations			
(U)	\$1,534	Develop and demonstrate technologies for improved at by allowing the pilot to perform daytime tactics at nigh	ircrew night vision goggles to increase mission effecti t. Incorporate and evaluate laser hardening technolog	veness and enhance air operations gies for image intensifier tube.			
F	Project 3257	Page	8 of 18 Pages	Exhibit R-2A (PE 0603231F)			

	RDT&I	DATE February 2002		
BUD(03 -	GET ACTIVITY • Advanced Tech	PROJECT Inel Protection 3257		
(U)	A. Mission Descript	ion Continued		
(U)	FY 2003 (\$ in Thous	ands) Continued		
(U)	\$1,457	Develop and demonstrate subsystems to protect th current and future high-performance fighter aircra for crewmembers wearing HMDs during high-spe to 600 Knots Equivalent Air Speed (KEAS) thresh	ne aircrew member wearing Helmet Mounted Devices (HM aft. Advanced head/neck protection systems will provide a eed emergency ejections. Conduct tests to verify head, nec hold, 700 KEAS objective.	IDs) during emergency ejection in decrease in head and neck injuries k, and eye protection are provided
(U)	\$5,938	Total		
(U)	<u>B. Project Change S</u> Not Applicable.	ummary		
(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program F Related Activities: PE 0602202F, Human PE 0602102F, Materi PE 0603112F, Advan PE 0603319F, Airbor PE 0604706F, Life So PE 0604201F, Integra This project has been	unding Summary (\$ in Thousands) a Effectiveness Applied Research. als. ced Materials for Weapon Systems. ne Laser Program. upport Systems. ted Avionics Planning and Development. coordinated through the Reliance process to harmo	nize efforts and eliminate duplication.	
(U)	D. Acquisition Strate Not Applicable.	egy		
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.			
Р	roject 3257	I	Page 9 of 18 Pages	Exhibit R-2A (PE 0603231F)

	RDT&E BUD	GET ITEM JU	STIFIC	ATION	SHEET	(R-2A E	xhibit)		DATI	Februa	ry 2002
BUDC 03 -	GET ACTIVITY • Advanced Technology	/ Development			PE NUMBE 060323 Techno	R AND TITLE 1F Crew logy	Systems	s and Per	rsonnel	Protectio	PROJECT 1 4923
	COST (\$ in Thousand	ds)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4923	Logistics Readiness and Susta	ainment	0	10,324	7,341	11,806	10,750	11,192	11,565	Continuing	TBD
(U)	E: Prof to FT 2002, enorts in this project were reported in PE 0003100F, Project 2745. <u>A. Mission Description</u> This project develops and demonstrates technologies that will enhance logistics, and improve the design, deployability, performance, and support of current and future weapon systems. This includes technology development to model and simulate intelligent behavior; improve the accuracy of logistics process modeling; create intelligent software agents to perfect human and logistics representation in large-scale military simulations; and create more effective logistics information systems. This project also develops and demonstrates technologies to incorporate human operator, maintenance, and support considerations into the weapon systems design process, and to make related data available electronically throughout weapon systems life cycles. The resulting efforts will reduce deployment airlift and footprint requirements, improve the logistics information system, and improve the command, control, and decision making in worldwide logistics management.										
(U) (U) (U)	FY 2001 (\$ in Thousands) \$0 FY 2001 \$0 Total	1 activity reported in I	PE 0603106	F, Project 27	745.						
(U) (U) (U)	 <u>FY 2002 (\$ in Thousands)</u> \$1,820 Develop and demonstrate technologies that will enhance and streamline aircraft maintenance 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. Continue development of diagnostics capability to provide technicians with more effective tools for isolating faults on software intensive, reconfigurable systems found on modern aircraft and advanced aircraft systems currently in development. Begin development of a prognostics capability to accurately predict when a component will fail so that parts can be replaced before failure. \$4,298 Develop and demonstrate intelligent software agents and realistic human behavior models. These software agents and models will add realism and fidelity to large-scale synthetic environments and war games, and improve the user interaction with logistics information systems. Develop intelligent agents that extend the role player's ability to monitor events and execute missions, and better represent logistics functions in synthetic exercises. Develop software agents that anticipate problems and offer decision options to command center personnel during mobility operations. 										
Р	Project 4923			Page	10 of 18 Pag	ges			E	xhibit R-2A (PE 0603231F)
					336						

	RDT&I	DATE February 2002						
BUD(03 -	BET ACTIVITY Advanced Tech	nnology Development	PE NUMBER AND TITLE 0603231F Crew Systems and Person Technology	PROJECT nel Protection 4923				
(U)	A. Mission Descript	ion Continued						
(U) (U)	<u>FY 2002 (\$ in Thous</u> \$4,206	ands) Continued Develop and demonstrate logistics technologies for im enhance deployments and mobility operations. Contin advanced logistics information and management capat problem identification, decision support aids, and proc commander and senior logisticians in effectively asses	proved deployment operations, supportability, and pla ue to develop technology to provide wing commander ilities, including rapid access to real-time resources st ess tracking. Focus will be on the information feeds r sing the wing logistics support status.	nning. These technologies will s and senior logisticians with atus information, proactive equired to support the wing				
(U)	\$10,324	Total						
(U)	FY 2003 (\$ in Thous	ands)						
(U)	Develop and demonstrate intelligent software agents and realistic human behavior models. These computer agents and models will add realism and fidelity to large-scale synthetic environments and war games, and improve the user interaction with logistics information systems. Develop intelligent software agents that mimic the functionality of command/control echelons and opposing forces and that better represent logistics functions in synthetic evercises.							
(U)	\$3,054	Develop and demonstrate logistics technologies for im will maximize the efficiency and effectiveness of Air I and the emerging Air Expeditionary Force concepts. C advanced logistics information and management capab problem identification, decision support, and process t	proved deployment operations and improved system s Force deployments and mobility operations in support Continue to develop technology to provide wing comm ilities, including rapid access to real-time resources st racking. Initial software tool set will be tested and tran	upportability. These technologies of agile combat support initiatives anders and senior logisticians with atus information, proactive nsitioned to users.				
(U)	\$1,642	Develop and demonstrate advanced user interface tech systems. These interfaces will combine artificial intell support technologies. Command and control operators sources, thereby enabling faster, more accurate decision	nologies to enhance the utility of Air Mobility Comma igence software with automated, work-centered collab will have immediate access to integrated, decision qu n making and problem resolution during mobility ope	and's command and control orative planning and decision ality information from multiple rations.				
(U)	\$7,341	Total						
(U)	B. Project Change S Not Applicable.	Summary						
Р	roject 4923	Page	1 of 18 Pages	Exhibit R-2A (PE 0603231F)				

RDT&E BUDGET ITEM JUSTIFICAT	DATE February 2002	
BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems and Pers Technology	PROJECT sonnel Protection 4923
 (U) C. Other Program Funding Summary (\$ in Thousands) (U) Related Activities: (U) PE 0602201F, Aerospace Flight Dynamics. (U) PE 0602202F, Human Effectiveness Applied Research. (U) PE 0603721N, Environmental Protection. (U) PE 0604708F, Civil, Fire, Environmental, Shelter. (U) PE 0604740F, Integrated Command & Control Applications. (U) PE 0605801A, Programwide Activities. (U) PE 0708011F, Industrial Preparedness. (U) This project has been coordinated through the Reliance process to ha (U) D. Acquisition Strategy Not Applicable. (U) E. Schedule Profile (U) Not Applicable. 	armonize efforts and eliminate duplication.	
Project 4923	Page 12 of 18 Pages	Exhibit R-2A (PE 0603231F)

	RDT&E	E BUDGET ITEM JU	STIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDG 03 -	BET ACTIVITY Advanced Tech	nology Development		PE NUMBER AND TITLE 0603231F Crew Systems and Person Technology					Protectio	PROJECT 1 4924	
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4924	Distributed Mission	Training Technology	0	6,730	7,532	6,664	7,369	7,387	7,392	Continuing	TBD
Note	 ote: Prior to FY 2002, efforts in this project were reported in PE 0603227F, Project 2743. J) <u>A. Mission Description</u> This project develops and demonstrates advanced training, simulation, and mission rehearsal technologies that will improve warfighter capabilities and mission readiness by enhancing operator and team performance skills. This effort includes the development of technologies that enable integration of computer models, live weapon systems, and weapon system simulators to portray the global battlespace, including all-weather, day/night flight operations, command and control, force protection, and aerospace operations. This project develops and demonstrates advanced training and simulation technologies that will improve warfighter readiness by enhancing mission training and mission rehearsal capabilities. Development and effective use of this global battlespace requires advances in training systems, interconnection, information, visual, and representation technologies. The resulting mission training and rehearsal capabilities will enhance the mission essential competencies of the combat and combat support individuals and teams that comprise the aerospace force. 										
(U) (U) (U)	<u>FY 2001 (\$ in Thousa</u> \$0 \$0	<u>unds)</u> FY 2001 activity reported in l Total	PE 0603227	F, Project 27	43.						
(U) (U)	50 FY 2002 (\$ in Thousands) \$1,811 Advance warfighter training capabilities by developing and demonstrating representational technologies and training techniques for integrated aerospace operations training which includes training for aerospace, command and control, force protection, and warfighters. Techniques will increase fidelity of mission training and rehearsal systems, reduce the learning time for new operators, sustain critical mission competencies, and ensure that deployed personnel have the knowledge and skills to accomplish their mission. Demonstrate training benefits of distributed mission training technology for fighter aircraft individual flying skills, fighter weapons school, and aircrew training program. Complete development of a tactical decision trainer for security forces. Begin development of data capturing tools for crew and team performance assessment in both simulator and field environments. Design and develop technologies for realistic databases and electronic combat simulators. \$1.082 Develop and demonstrate the application of information and computivitient technologies for realistic mission training and here the second develop technologies for realistic databases and electronic combat simulators.										
P	roject 4924	-	- *	Page	13 of 18 Pag	ges	C		E>	chibit R-2A (PE 0603231F)

	RD	T&E BUDGET ITEM JUSTIFICATION S	HEET (R-2A Exhibit)	DATE February 2002				
BUD0 03 -	GET ACTIVITY - Advanced 1	Fechnology Development	PE NUMBER AND TITLE 0603231F Crew Systems and Person Technology	PROJECT nel Protection 4924				
(U)	A. Mission Des	cription Continued						
(U) (U)	<u>FY 2002 (\$ in T</u> \$1,584	housands) Continued in a distributed simulation environment. These technol systems within a horizontally and vertically integrated communication bridge to enable virtual simulators, ope environment. Develop and demonstrate enhancements federations and enhanced simulator performance. Dev and control centers. Evaluate techniques for integratin (DMT) environment. Demonstrate advances in simulator visual system techni-	logies will increase readiness training by enabling mo- system of sensors, command and control, and weapon erating at different security levels, to interact with one to the High-Level Architecture that will enable more elop a testbed for command and control training resea g operational command and control systems into the I mologies through the development of high fidelity images	re realistic employment of weapon as platforms. Design a another in a real-time simulation rapid development of simulator rch with links to existing command Distributed Mission Training ge generation, display, and				
	bridges at realistic tactical ranges or to properly assess their aspect angle, increasing mission rehearsal capability for the warfighter. Co development of a PC-based high resolution real-time image generator. Continue development of an ultra-high resolution laser projecto DMT simulators.							
(U)	\$1,352	Develop and demonstrate technologies for high fidelity preview, and rehearsal capabilities. This development operation mission pretraining prior to in-aircraft training environmental changes. Test the use of an automated a may increase the capability to rapidly respond to world effectiveness of on-line NVG and laser courseware, an	v Night Vision Goggle (NVG) simulation to support at will reduce the cost of initial NVG qualification, allow ng, and increase combat training realism by adding sin material classification toolset for rapid build of multi- class with realistic visualization of the new or char d assess impact of these technologies on mission effect	nd increase mission training, w for effective advanced night nulated weather, seasonal, and spectral databases. This toolset anging operating areas. Evaluate ctiveness and risk management.				
(U)	\$6,730	Total	I					
(U)	<u>FY 2003 (\$ in T</u>	'housands)						
(U)	\$2,418	Advance warfighter training capabilities by developing integrated training and rehearsal, which includes training warfighters. Develop and validate training technologie Implement and evaluate the next generation threat syst Develop functional requirements for hyperspectral data	g and demonstrating representational technologies and ng for aerospace operations, command and control, fo es and methods to enable deployed personnel to mainta em in DMT testbed, while integrating with multi-hype abases to support realistic sensor simulation.	simulation techniques for rce protection, and air base defense ain mission essential skills. erspectral and weather databases.				
Р	Project 4924	Page 1	4 of 18 Pages	Exhibit R-2A (PE 0603231F)				
			340					

	RDT&	E BUDGET ITEM JUSTIFICATI	ON SHEET (R-2A Exhibit)	DATE February 2002					
BUD 03	GET ACTIVITY - Advanced Tecl	nnology Development	PE NUMBER AND TITLE 0603231F Crew Systems Technology	PROJECT s and Personnel Protection 4924					
(U)	A. Mission Descript	ion Continued							
(U) (U)	<u>FY 2003 (\$ in Thous</u> \$1,845	ands) Continued Develop and demonstrate the application of inf in a distributed simulation environment. These systems within a horizontally and vertically int capability to establish a High Level Architectur audiences. Demonstrate a High Level Architectur	formation and communications technologies e technologies will increase readiness training tegrated system of sensors, command and com- re federation that provides aircrew and com- cture federation operating at multiple securi-	s for realistic mission training and mission rehearsal ng by enabling more realistic employment of weapon ontrol, and weapons platforms. Demonstrate the mand and control training to geographically separate ty levels.					
(U)	(U) \$1,807 Demonstrate advances in simulator visual system technologies through the development of high fidelity image generator display, component and databases. Advanced visual systems will provide operators enhanced cuing in simulated high-definition immersive environments and greater visual detail to identify other aircraft, ground vehicles, roads, and bridges at realistic tactical ranges, thus increasing mission rehears capability for the warfighter. Develop and demonstrate less expensive, optical infinity display components for the simulator. Develop and demonstrate a proof-of-concept ultra-high resolution, color laser projector. Integrate and evaluate high bandwidth PC-based image generation and evaluate high bandwidth PC-based image generation and evaluate high bandwidth PC-based image generation.								
(U)	\$1,462	Develop and demonstrate technologies for night development will reduce the cost of initial NVG generic Forward Looking Infra-Red simulation visible and sensor simulation imagery. Develo Complete digital conversion of introductory and spatial orientation, and advanced combat night Total	nt vision device training and high fidelity N G qualification and increase combat training a using same tools used for NVG functional op proof-of-concept for dual mode, covert and instructor courseware. Evaluate simulato operations.	ight Vision Goggle (NVG) simulation. This g realism. Complete generic NVG simulation and ity, allowing for high-fidelity, completely correlated nd overt, external aircraft lighting for F-15C. r-based training scenarios for initial qualification,					
(U) (U)	\$7,552B. Project Change S	Summary							
(0)	Not Applicable.	<u></u>							
(U) (U) (U) (U) (U)	C. Other Program I Related Activities: PE 0602202F, Huma PE 0604227F, Distrib This project has been	Funding Summary (\$ in Thousands) n Effectiveness Applied Research. buted Mission Training. coordinated through the Reliance process to har	monize efforts and eliminate duplication.						
F	Project 4924		Page 15 of 18 Pages	Exhibit R-2A (PE 0603231F)					
			3/1						

	RDT&E BUDGET ITEM JUSTIFIC	DATE February	2002		
BUD 03 ·	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems and Technology	d Person	nel Protection	PROJECT 4924
(U)	D. Acquisition Strategy Not Applicable.				
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.				
F	Project 4924	Page 16 of 18 Pages		Exhibit R-2A (PE	0603231F)
		342			

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)									DATE February 2002	
BUDC 03 -	GET ACTIVITY Advanced Tech	nology Development			PE NUMBE 060323 Techno	R AND TITLE	Systems	s and Per	sonnel I	Protection	PROJECT n 5020
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5020	Directed Energy Pro	otective Systems	0	0	2,641	2,904	3,965	3,049	3,257	Continuing	TBD
Note Rese	ote: In FY 2003, the Directed Energy Protective Systems program at Brooks AFB will move from Project 3257 to Project 5020 to align resources with the Air Force esearch Laboratory organization.										
(U)	J) <u>A. Mission Description</u> 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. The project develops technologies to provide protection against laser threats and hazards, 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) (U) (U)	<u>FY 2001 (\$ in Thousa</u> \$0 \$0	<u>ands)</u> FY 2001 activity reported in l Total	PE 0603231	F, Project 32	257.						
(U) (U) (U)	<u>FY 2002 (\$ in Thousa</u> \$0 \$0	<u>ands)</u> FY 2002 activity reported in l Total	PE 06032311	F, Project 32	257.						
(U) (U) (U)	FY 2003 (\$ in Thousands) \$590 Develop and demonstrate LEP technologies in the form of spectacles and visors for aircrew and ground personnel to provide protection from lasers while minimizing negative impacts on vision. Evaluate protective performance, visual acuity impacts, life support equipment compatibility, and aircrew acceptability of next-generation, fixed-line tristimulus protection against multiple visible wavelengths. (*) \$1,330 Develop and demonstrate agile LEP technologies for aircrew and ground personnel. Technologies will result in a single device that can be used by all aircrew for protection against any/all laser hazards or threats. Continue development and integration of LEP with Integrated Panoramic Night Vision Goggles. Continue design, development, and evaluation of a Laser Familiarization Program for warfighters toward integration with Distributed Mission Training system. Continue supporting development and evaluation of a Laser Detector and Warning system toward integration into aircraft cockpits and with agile LEP.										
Р	roject 5020			Page	17 of 18 Pag	ges			E>	(hibit R-2A ((PE 0603231F)

	RDT&E	DATE February 2002		
BUD(03 -	GET ACTIVITY Advanced Tech	PROJECT nel Protection 5020		
(U) (U) (U)	A. Mission Description FY 2003 (\$ in Thousan \$721	on Continued ands) Continued Develop and demonstrate technologies that permit safe Assessment technology into laser range hazard assessm airborne laser flight tests. Continue to evaluate the bio pulse (sub-microsecond) high-energy laser pulses. Con Total	testing, deployment, and use of high-energy laser we nent tools for use by test ranges with high-energy laser logical effects of high-energy laser systems. Conduct ntinue to evaluate the biological effects of non-lethal 1	apons. Integrate probabilistic Risk weapon systems, including damage threshold studies on short aser weapons.
(U) (U)	B. Project Change S Not Applicable.	ummary		
(U) (U) (U) (U) (U) (U)	C. Other Program Fr PE 0602102F, Materia PE 0602202F, Human PE 0603112F, Advand PE 0603319F, Airborr PE 0604706F, Life Su	anding Summary (\$ in Thousands) als. Effectiveness Applied Research. ced Materials for Weapon Systems. ne Laser Program. pport Systems.		
(U)	D. Acquisition Strate Not Applicable.	gy		
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.			
Р	roject 5020	Page 1	8 of 18 Pages	Exhibit R-2A (PE 0603231F)

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										ry 2002
BUDG 03 -	GET ACTIVITY • Advanced Te	chnology Development			PE NUMBE	r and title 5F Fligh	t Vehicle	Technol	ogy Inte	gration	PROJECT 2568
	COST	(\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2568	Flight Vehicle Te	echnology Integration	17,225	0	0	0	0	0	0	Continuing	TBD
	Quantity of RDT	&E Articles	0	0	0	0	0	0	0	0	0
Note	ote: In FY 2002, efforts transferred to PE 0603211F, Project 4920.										
	This program integrates and demonstrates advanced flight vehicle technologies that will improve the performance and supportability of existing and future manned and unmanned aerospace vehicles. System level integration brings together the aerospace vehicle technologies along with avionics, propulsion, and weapon systems to flight demonstrate them in a near-realistic operational environment. Integration and flight test demonstrations reduce the risk and time required to transition technologies into operational aircraft. This program provides proven aerospace vehicle technologies for all-weather, day or night operations, and technologies for improved affordability.										
(U)	FY 2001 (\$ in Tho	ousands)									
(U)	\$10,578	Developed and demonstrated vehicle goals. Demonstrated and advanced materials techn and the integration of human	technologie lightweight ologies for a system inter	s to support /low-cost co iffordable lo face technol	the joint Air mposite stru w-observabl ogies for adv	Force/Defer ctures, multi es. Demons vanced manr	nse Advance ifunction apo trated advan ned and unm	d Research l ertures, comp ced weapons anned opera	Projects Age pact low-obs s suspension tions.	ency unmann servable inlet and release	ed combat air is and exhaust, technologies,
(U)	\$925	Developed and demonstrated tested advanced vehicle mana affordability goals. Complete	advanced fli gement tech	ight control mology with	techniques for advanced sy ol technolog	or affordable stem prognov v specificati	e and reliable ostics and au on for unma	e autonomou itonomous co nned air veh	s control. In ontrol softward	ntegrated, de are to achiev	veloped, and e reliability and
(U)	\$1,907	Initiated Congressionally dire explosion resistant fuel tank l	cted effort to	o address ad als.	vanced tech	ology devel	lopment of e	xplosionissu	es associate	d with integr	ation of
(U)	\$3,815	Initiated Congressionally directly evaluation of future strike mi	ected efforts	to conduct a	a Trans-Atm dentify techr	ospheric Ae	erospace Plan must be pur	ne (TAAP) s sued by the	tudy, to pro [.] Air Force.	vide a compi	ehensive
(U)	\$17,225	Total				lorogies that	must se pui	succes of the			
P	roject 2568			Pag	e 1 of 3 Page	es			E	Exhibit R-2 (PE 0603245F)
					3/15						

	RDT&E BUDGET ITEM JUSTIFICATION	DATE Februar	y 2002		
BUDO	GET ACTIVITY	PE NUMBER AND TITLE	-		PROJECT
03 -	- Advanced Technology Development	0603245F Flight Vel	hicle Technolo	ogy Integration	2568
(U)	A. Mission Description Continued				
(U) (U) (U)	FY 2002 (\$ in Thousands)\$0Efforts transferred to PE 0603211F, Aerospace Struc\$0Total	tures, Project 4920, Flight Vehi	cle Tech Integratio	n.	
(U) (U) (U)	FY 2003 (\$ in Thousands)\$0No Activity\$0Total				
(U)	<u>B. Budget Activity Justification</u> This program is in Budget Activity 3, Advanced Technology Development, system developments that have military utility and address warfighter needs	since it develops and demonstr	ates technologies fo	or existing system upgrad	es and/or new
(U)	C. Program Change Summary (\$ in Thousands)				
(U)	Previous President's Budget	<u>FY 2001</u> 17,960	<u>FY 2002</u> 0	<u>FY 2003</u> 0	<u>Total Cost</u>
(U) (U)	Appropriated Value Adjustments to Appropriated Value a Congressional/General Reductions	18,126	0		
	b. Small Business Innovative Researchc. Omnibus or Other Above Threshold Reprogram	-426			
	d. Below Threshold Reprogram	-309			
(U)	e. Rescussions Adjustments to Budget Years Since FY 2002 PBR	-160			
(U)	Current Budget Submit/FY 2003 PBR	17,225	0	0	TBD
(U)	Significant Program Changes: In FY 2002, efforts transferred to PE 0603211F, Project 4920.				
P	Project 2568 Pag	ge 2 of 3 Pages		Exhibit R-2 (F	PE 0603245F)
	UNC	346 CLASSIFIED			

	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 20	02	
BUD0 03 -	GET ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603245F Flight Vehicle Technology	Integration	PROJECT
(U) (U) (U) (U) (U) (U)	D. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602201F, Aerospace Vehicle Technology PE 0603106F, Logistics Systems Technology. PE 0603211F, Aerospace Technology Dev/Demo This project has been coordinated through the Reliance process to harmonize	efforts and eliminate duplication.		
(U)	E. Acquisition Strategy Not Applicable.			
(U) (U)	F. Schedule Profile Not Applicable.			
Р	roject 2568 Page	e 3 of 3 Pages	Exhibit R-2 (PE 06	03245F)
	UNC	347 LASSIFIED		

THIS PAGE INTENTIONALLY LEFT BLANK

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)									DATE February 2002		
BUDGET ACTIVITY PE NUMBER AND TITLE 03 - Advanced Technology Development 0603253F Advanced Sensor Integration												
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost		
	Total Program Element (PE) Cost	5,061	0	0	0	0	0	0	Continuing	TBD		
2735	Avionics Integration Technology	1,885	0	0	0	0	0	0	Continuing	TBD		
666A	Sensor Fusion & Integration Tech	3,176	0	0	0	0	0	0	Continuing	TBD		
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0		
IN FY	<u>A. Mission Description</u> This program develops and demonstrates advanced r Specifically, this program develops and improves: d advanced Global Positioning System receivers and a technologies for low-probability-of-detection comm to evaluate methods for integrating on-board and off	adio frequer ligital receiv nti-jam tech unication be	sterred to Pl acy sensors a er componer niques for ac tween aircra or data.	and integration ints for air more crospace plat ft to improve	project 665 on technique oving target forms; aircr aircrew situ	A. s for intellig indication ar aft communi uational awa	ence, survei ad advanced cations, nav reness; and o	llance, and 1 unmanned a igation, and collaborative	reconnaissan aerial vehicle identificatio e engineering	ce functions. e applications; n technologies; g environments		
(U)	J) <u>B. Budget Activity Justification</u> 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.											
(U)	C. Program Change Summary (\$ in Thousands)				EV 200	1 5	Y 2002	FV 204	13	Total Cost		
(U) (U)	Previous President's Budget Appropriated Value				5,30	<u> </u>	0	<u>1°1 20</u>	0	<u>10tai C0st</u>		

(U) Adjustments to Appropriated Value a. Congressional/General Reductions

Page 1 of 6 Pages

Exhibit R-2 (PE 0603253F)

	RDT&E BUDGET ITEM JUSTIFICATI	DATE Februa	ary 2002					
вира 03 -	BET ACTIVITY • Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced	PE NUMBER AND TITLE 0603253F Advanced Sensor Integra					
(U)	 C. Program Change Summary (\$ in Thousands) Continued b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram e. Rescissions 	<u>FY 2001</u> -126 -114 -49	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>			
(U) (U)	Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR	5.061	0	0	TBD			
	In FY 2002, the remaining efforts in Projects 2/35 and 666A were tran	Isferred to PE 0603203F, Project 665	ЭΑ.					
		Page 2 of 6 Pages		Exhibit R-2	(PE 0603253F)			

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)										ary 2002
BUDO 03 -	JDGET ACTIVITY PE NUMBER AND TITLE PROJECT 3 - Advanced Technology Development 0603253F Advanced Sensor Integration 2735										
	COST (\$ in Thousa	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost	
2735	Avionics Integration Techno	blogy	1,885	0	0	0	0	0	(Continuing	TBD
In FY (U)	 FY 2002, the remaining efforts in this project were transferred to PE 0603203F, Project 665A. J) <u>A. Mission Description</u> This project develops and demonstrates advanced radio frequency (RF) sensors for integrated intelligence, surveillance, and reconnaissance (ISR) functions on aerospace platforms. These advanced technologies will enable sensors to gather and process information from air- and space-based assets, integrate on-board and 										
(U) (U) (U)	 off-board sensor data, and perform sensor management functions. <u>FY 2001 (\$ in Thousands</u>) \$1,885 Developed and demonstrated advanced modular, sharable digital RF sensor technologies for aerospace sensor suites performing ISR applications. Fabricated and tested dual-use, modular, digital RF receiver components for multimode radar operation. (In FY 2002, this work was transferred to PE 0603203F, Project 665A.) \$1 885 Total 										
(U) (U) (U)	FY 2002 (\$ in Thousands)\$0Effort\$0Total	t transferred to PE 0603	203F, Projec	t 665A.							
(U) (U) (U)	FY 2003 (\$ in Thousands)\$0No Ad\$0Total	ctivity									
(U)	U) <u>B. Project Change Summary</u> Not Applicable.										
P	roject 2735			Page	e 3 of 6 Page	es			E	xhibit R-2A	(PE 0603253F)

RDT&E BUDGET ITEM JUSTIFICA	DATE February 2002	
BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Sensor Integrat	PROJECT
 (U) <u>C. Other Program Funding Summary (\$ in Thousands)</u> (U) Related Activities: (U) PE 0603204F, Aerospace Sensors. (U) PE 0603203F, Advanced Aerospace Sensors. (U) PE 0603270F, Electronic Combat Technology. (U) This project has been coordinated through the Reliance process to 	harmonize efforts and eliminate duplication.	
(U) D. Acquisition Strategy Not Applicable.		
 (U) <u>E. Schedule Profile</u> (U) Not Applicable. 		
Project 2735	Page 4 of 6 Pages	Exhibit R-2A (PE 0603253F)
	352 UNCLASSIFIED	

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) DATE February 2002									
виро 03 -	UDGET ACTIVITY PE NUMBER AND TITLE 03 - Advanced Technology Development 0603253F Advanced Sensor Integration							gration		PROJECT 666A
	COST (\$ in Thousands)FY 2001 ActualFY 2002 EstimateFY 2003 EstimateFY 2004 EstimateFY 2005 EstimateFY 2006 EstimateFY 2006 Estimate						FY 2007 Estimate	Cost to Complete	Total Cost	
666A	Sensor Fusion & Integration Tech	3,176	0	0	0	0	0	0	Continuing	TBD
In FY	2002, the remaining efforts in this project were trans	sferred to PE	E 0603203F,	Project 665	4.					1
	information links for future Air Force information architectures. Specifically, this project develops the advanced techniques for exploiting and protecting the capabilities of the Global Positioning System (GPS) to provide highly accurate reference data for precision targeting and location of enemy air defense radars. In addition, this project develops high-speed, jam-resistant, low-probability-of-detection information transmission technologies and techniques to improve overall aircrew situational awareness, reduce electromagnetic signatures of navigation and communication systems, and increase aircraft survivability. The focus is on transitioning transceivers, inertial components, and navigation system technology into air vehicles. Technologies demonstrated under this project are needed for real-time information-in-the-cockpit, stealth operations, precision targeting and strike, timely bomb damage assessment, force multiplication through multiplatform shared resources, and supportable weapon systems.									
(U) (U)	FY 2001 (\$ in Thousands)\$3,176Developed technologies to m combat capabilities. Refined modernization candidate mili 665A.)	aximize GPS GPS receive tary signals	5 jam resista er processing for exploitat	nce, positior g technology ole vulnerabi	al accuracy, and direct s lities. (In F	and exploit ignal acquis Y 2002, this	ation technic ition techniq effort was tr	ues to imprues. Contin ansferred to	ove offensiv ued evaluati PE 0603203	e and defensive on of GPS 3F, Project
(U)	\$3,176 Total									
(U) (U) (U) (U)	FY 2002 (\$ in Thousands)\$0Effort transfers to PE 060320\$0TotalFY 2003 (\$ in Thousands)\$0Nic Activity)3F, Project (565A.							
(U) (U)	\$0 No Activity \$0 Total									
Ρ	roject 666A		Pag	e 5 of 6 Page	es			Ex	hibit R-2A	(PE 0603253F)
				353						

	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 2002	
вирс 03 -	GET ACTIVITY • Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Sensor Integrat	PROJECT
(U) (U) (U) (U) (U) (U)	 B. Project Change Summary Not Applicable. C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602204F, Aerospace Sensors. PE 0602782A, Command, Control, Communications Technology. PE 0602232N, Navy C3 Technology. 		
(U) (U) (U)	PE 0603203F, Advanced Aerospace Sensors. PE 0603270F, Electronic Combat Technology. This project has been coordinated through the Reliance process to harmonize	e efforts and eliminate duplication.	
(U)	D. Acquisition Strategy Not Applicable.		
(U) (U)	E. Schedule Profile Not Applicable.		
Р	Project 666A Pag	ge 6 of 6 Pages	Exhibit R-2A (PE 0603253F)
		354	

								DATE		
	RDT&E BUDGET ITEM J	CATION	SHEET	SHEET (R-2 Exhibit)				February 2002		
BUDGET ACTIVITY 03 - Advanced Technology Development					R AND TITLE	ronic Co	mbat Teo	chnology	1	
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	26,391	32,405	23,350	27,773	27,047	26,302	27,165	Continuing	TBD
2432	Defensive System Fusion Technology	9,362	8,307	8,110	8,251	7,815	6,058	5,529	Continuing	TBD
431G	RF Warning & Countermeasures Tech	7,672	8,402	6,009	6,906	6,618	7,814	8,990	Continuing	TBD
691X	EO/IR Warning & Countermeasures Tech	9,357	15,696	9,231	12,616	12,614	12,430	12,646	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

In FY 2003, space unique tasks in this PE, Projects 431G and 691X, will be transferred to PE 0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) <u>A. Mission Description</u>

This program develops and demonstrates technologies to support Air Force electronic combat (EC) requirements. The program focuses on developing components, subsystems, and technologies with potential aerospace combat, special operations, and airlift EC applications in three project areas. The first project develops and demonstrates technologies for integrating EC sensors and systems into a fused and seamless whole. The second project develops and demonstrates advanced technologies for radio frequency EC suites. The third project develops and demonstrates advanced warning and countermeasure technologies to defeat electro-optical, infrared, and laser threats to aerospace platforms. Note: In FY 2002, Congress added \$1.0 million for the Integrated Demonstrations and Applications Laboratory's Coherent Command, Control, Communications, Navigation, and Identification Signal Simulations, and \$3.5 million for Closed-Loop Infrared Countermeasures.

(U) <u>B. Budget Activity Justification</u>

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 EC system developments that have military utility and address warfighter needs.

Page 1 of 11 Pages

Exhibit R-2 (PE 0603270F)

	RDT&E BUDGET ITEM JUSTIFICA	oit)	DATE Febru	ary 2002		
BUD0 03 -	GET ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electroni	PE NUMBER AND TITLE 0603270F Electronic Combat Tech			
(U)	C. Program Change Summary (\$ in Thousands)					
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>	
(U)	Previous President's Budget	26,636	28,221	29,559		
(U)	Appropriated Value	26,882	32,721			
(U)	Adjustments to Appropriated Value					
	a. Congressional/General Reductions		-316			
	b. Small Business Innovative Research	-631				
	c. Omnibus or Other Above Threshold Reprogram					
	d. Below Threshold Reprogram	386				
	e. Rescissions	-246				
(U)	Adjustments to Budget Years Since FY 2002 PBR			-6,209		
(U)	Current Budget Submit/FY 2003 PBR	26,391	32,405	23,350	TBD	
	In FY 2003, space unique tasks in this PE, Projects 431G and 691X, recommendation to consolidate all space unique activities.	will be transferred to PE 0603500F, P	roject 5034, in con	junction with the Space	• Commission	
		Page 2 of 11 Pages		Exhibit R-2	(PE 0603270F)	

BUDGET ACTIVITY PENUMBER AND TITLE PROJECT 03 - Advanced Technology Development 0603270F Electronic Combat Technology 2432 cost (\$ in Thousands) FY 2001 Actual FY 2002 Estimate FY 2003 Estimate FY 2005 Estimate FY 2005 Estimate FY 2005 Estimate FY 2005 Estimate FY 2005 Estimate FY 2007 Estimate Complete Total Cost 2432 Defensive System Fusion Technology 9.362 8.307 8.110 8.251 7.815 6.068 5.529 Continuing (U) A.Mission Description This project develops and demonstrates technologies for integrating electronic combat (EC) sensors and EC system fusion. It develops advanced algorithms and assessment techniques needed to avaliate and enable combat aircraft operations in multi-spectral threat and countermeasures for denial, disruption, and suppression of adversary air defense operations. Technologies included are: 1) advanced components and techniques needed to jam enemy radars; 2) advanced standoff jammer technologies included are: 1) advanced components and techniques needed to against modern digital C2 network links. Designed sensors to enhance situational avareness in both new and existing aerospace platforms. As part of an international cooperative Real-Time Information avareness in both new and existing aerospace platforms. As part of an international cooperative Real-Time Information in-the-Cockpit effort, performed design of optimized sensor fusion algorithms and processor hardware for joint coalition platforms.		RDT&	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	rv 2002
COST (\$ in Thousands) FY 2001 Actual FY 2002 Estimate FY 2004 Estimate FY 2005 Estimate FY 2007 Estimate Cont to Complete 2432 Defensive System Fusion Technology 9.362 8.307 8.110 8.251 7.815 6.058 5.529 Continuing (U) A.Mission Description This project develops and demonstrates technologies for integrating electronic combat (EC) sensors and EC system Fusion. It develops advanced algorithms and assessment technologies required for command and control (C2) warfare, standoff jamming, and support countermeasures for denial, disruption, and supports on a diversary air defense operations. Technologies in cluded are: 1) advanced components and techniques needed to jam enemy radars; 2) advanced standoff jammer technologies; and 3) electronic collection methods to inform field commanders of changes in the electronic environment. FY 2001 (S in Thousands) Estimate Fy 2001 (S in Thousands) (U) \$2,193 Developed low-cost technologies to demonstrate data fusion (e.g., threat recognition, targeting, etc.) from off-board and on-board sensors to enhance situational avareness. Conducted aboard sensor fusion algorithms and processor hardware for joint coalition platforms. (U) \$3,847 Developed and investigated offensive counter information warfar	BUDG 03 -	BUDGET ACTIVITY PE NUMBER AND TITLE 03 - Advanced Technology Development 0603270F Electronic Combat Technology							,	PROJECT 2432		
2432 Defensive System Fusion Technology 9.362 8.307 8.110 8.251 7.815 6.068 5.528 Continuing (U) A. Mission Description This project develops and demonstrates technologies for integrating electronic combat (EC) sensors and EC system fusion. It develops advanced algorithms and assessment techniques needed to evaluate and enable combat aircraft operations in multi-spectral threat and countermeasures for denial, disruption, and suppression of adversary air defense operations. Technologies included are: 1) advanced components and techniques needed to jam enemy radars; 2) advanced standoff jammer technologies; and 3) electronic collection methods to inform field commanders of changes in the electronic environment. (U) FY 2001 (S in Thousands) (U) 52,193 Developed low-cost technologies to demonstrate data fusion (e.g., threat recognition, targeting, etc.) from off-board and on-board sensors to enhance situational awareness in both new and existing aerospace platforms. As part of an international cooperative Real-Time Information-in-the-Cockpit effort, performed design of optimized sensor fusion algorithms and processor hardware for joint coalition platforms. (U) \$3,847 Developed and investigated offensive counter information warfare technologies to disrupt and/or deny adversarial C2 nodes and networks. Continued threat exploitation. Conducted ground/field testing of brassboard against modern digital C2 network links. Designed experimental hardware and software to counter adversarial communication and navigation systems. (U) \$2,767 Conducted evaluations and risk reduction demonstrations of		COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
 (U) <u>A.Mission Description</u> This project develops and demonstrates technologies for integrating electronic combat (EC) sensors and EC system fusion. It develops advanced algorithms and assessment technologies required for command and control (C2) warfare, standoff jamming, and support countermeasures for denial, disruption, and suppression of adversary air defense operations. Technologies included are: 1) advanced components and techniques needed to jam enemy radars; 2) advanced standoff jammer technologies; and 3) electronic collection methods to inform field commanders of changes in the electronic environment. (U) <u>FY 2001 (S in Thousands</u>) (U) \$2,193 Developed low-cost technologies to demonstrate data fusion (e.g., threat recognition, targeting, etc.) from off-board and on-board sensors to enhance situational awareness in both new and existing aerospace platforms. As part of an international cooperative Real-Time Information-in-the-Cockpit effort, performed design of optimized sensor fusion algorithms and processor hardware for joint coalition platforms. (U) \$3,847 (U) \$3,847 (U) \$2,767 (Conducted evaluations and risk reduction demonstrations of defensive sensors and fusion of multiple information sources for situational awareness. Conducted laboratory evaluations of receiver technology for advanced fighter applications. Navigation, and Identification (C3NI) signal simulation for joint survivability demonstration. Laboratory (IDAL) Coherent Command, Control, Communications, Navigation, and Identification (C3NI) signal simulation for joint survivability demonstrations to defensive sensors. Conducted radio frequency air defense systems. Conducted trade study analyses for techniques to defeat future threat radar guided missile systems. (U) \$2,767 (D) Solution and radia control trade study analyses for techniques to defeat future threat radar guid	2432	Defensive System	Fusion Technology	9,362	8,307	8,110	8,251	7,815	6,058	5,529	Continuing	
 (U) <u>FY 2001 (\$ in Thousands)</u> (U) \$2,193 Developed low-cost technologies to demonstrate data fusion (e.g., threat recognition, targeting, etc.) from off-board and on-board sensors to enhance situational awareness in both new and existing aerospace platforms. As part of an international cooperative Real-Time Information-in-the-Cockpit effort, performed design of optimized sensor fusion algorithms and processor hardware for joint coalition platforms. (U) \$3,847 Developed and investigated offensive counter information warfare technologies to disrupt and/or deny adversarial C2 nodes and networks. Continued threat exploitation. Conducted ground/field testing of brassboard against modern digital C2 network links. Designed experimental hardware and software to counter adversarial communication and navigation systems. (U) \$2,767 Conducted evaluations and risk reduction demonstrations of defensive sensors and fusion of multiple information sources for situational awareness. Conducted laboratory evaluations of receiver technology for advanced fighter applications. Integrated Navy and Air Force Integrated Demonstrations and Applications Laboratory (IDAL) Coherent Command, Control, Communications, Navigation, and Identification (C3NI) signal simulation for joint survivability demonstrations. (U) \$9,362 Total 	(U)	U) <u>A. Mission Description</u> This project develops and demonstrates technologies for integrating electronic combat (EC) sensors and EC system fusion. It develops advanced algorithms and assessment techniques needed to evaluate and enable combat aircraft operations in multi-spectral threat and countermeasure environments. It also matures technologies required for command and control (C2) warfare, standoff jamming, and support countermeasures for denial, disruption, and suppression of adversary air defense operations. Technologies included are: 1) advanced components and techniques needed to jam enemy radars; 2) advanced standoff jammer technologies; and 3) electronic collection methods to inform field commanders of changes in the electronic environment.										
 (U) \$3,847 Developed and investigated offensive counter information warfare technologies to disrupt and/or deny adversarial C2 nodes and networks. Continued threat exploitation. Conducted ground/field testing of brassboard against modern digital C2 network links. Designed experimental hardware and software to counter adversarial communication and navigation systems. (U) \$2,767 Conducted evaluations and risk reduction demonstrations of defensive sensors and fusion of multiple information sources for situational awareness. Conducted laboratory evaluations of receiver technology for advanced fighter applications. Integrated Navy and Air Force Integrated Demonstrations and Applications Laboratory (IDAL) Coherent Command, Control, Communications, Navigation, and Identification (C3NI) signal simulation for joint survivability demonstrations. (U) \$555 Developed affordable threat alert technologies for combat aircraft to increase survivability against advanced, integrated radio frequency air defense systems. Conducted trade study analyses for techniques to defeat future threat radar guided missile systems. (U) \$9,362 Total 	(U) (U)	 <u>FY 2001 (\$ in Thousands</u>) \$2,193 Developed low-cost technologies to demonstrate data fusion (e.g., threat recognition, targeting, etc.) from off-board and on-board sensors to enhance situational awareness in both new and existing aerospace platforms. As part of an international cooperative Real-Time Information-in-the-Cockpit effort, performed design of optimized sensor fusion algorithms and processor hardware for joint coalition 										
 (U) \$2,767 Conducted evaluations and risk reduction demonstrations of defensive sensors and fusion of multiple information sources for situational awareness. Conducted laboratory evaluations of receiver technology for advanced fighter applications. Integrated Navy and Air Force Integrated Demonstrations and Applications Laboratory (IDAL) Coherent Command, Control, Communications, Navigation, and Identification (C3NI) signal simulation for joint survivability demonstrations. (U) \$555 Developed affordable threat alert technologies for combat aircraft to increase survivability against advanced, integrated radio frequency air defense systems. Conducted trade study analyses for techniques to defeat future threat radar guided missile systems. (U) \$9,362 Total 	(U)	\$3,847	Developed and investigated o Continued threat exploitation hardware and software to cou	ffensive cou . Conducted nter adversa	inter informa l ground/fiel rial commu	ation warfare d testing of b nication and	technologie brassboard a navigation s	es to disrupt gainst mode vstems.	and/or deny rn digital C2	adversarial network lin	C2 nodes and ks. Designe	d networks. d experimental
 (U) \$555 Developed affordable threat alert technologies for combat aircraft to increase survivability against advanced, integrated radio frequency air defense systems. Conducted trade study analyses for techniques to defeat future threat radar guided missile systems. (U) \$9,362 Total 	(U)	 \$2,767 Conducted evaluations and risk reduction demonstrations of defensive sensors and fusion of multiple information sources for situational awareness. Conducted laboratory evaluations of receiver technology for advanced fighter applications. Integrated Navy and Air Force Integrated Demonstrations and Applications Laboratory (IDAL) Coherent Command, Control, Communications, Navigation, and Identification (C3NI) signal simulation for joint survivability demonstrations. 										
(U) \$9,362 Total	(U)	\$555 Developed affordable threat alert technologies for combat aircraft to increase survivability against advanced, integrated radio frequency air defense systems. Conducted trade study analyses for techniques to defeat future threat radar guided missile systems										
	(U)	\$9,362	Total		,	1			2	<u>,</u>		
Project 2432 Page 3 of 11 Pages Exhibit R-2A (PE 0603270F)	Ρ	roject 2432			Page	e 3 of 11 Pag	es			Ex	hibit R-2A ((PE 0603270F)

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) DATE February 2002									
виро 03 -	BET ACTIVITY Advanced Tec	hnology Development	PE NUMBER AND TITLE 0603270F Electronic Combat Techno	PROJECT logy 2432						
(U)	A. Mission Descrip	tion Continued								
(U)	FY 2002 (\$ in Thou	sands)								
(U)	\$2,282 Develop and investigate offensive counter information warfare technologies to disrupt and/or deny adversarial C2 nodes and networks. Complete laboratory tests and subsequently demonstrate the advanced electronic attack (EA) techniques to counter modern digital C2 network links. Analyze and evaluate technical data to determine technique effectiveness. Integrate hardware/software and conduct laboratory tests to evaluate EA techniques to counter adversarial communication and navigation systems. Continue the detailed planning process for ground and flight tests. Develop offensive countermeasures against high-speed, wideband data links for use by multiple ground-based and airborne platforms.									
(U)	\$302	Develop and implement advanced hardware-in-the-loo (IDAL) to conduct evaluations and risk reduction dem situational awareness. Develop and conduct IDAL rist technologies for real-time threat situational awareness	op threat simulators in the Integrated Demonstrations a constrations of defensive sensors and fusion of multiple k reduction evaluations and demonstrations that evolve.	nd Applications Laboratory information sources for advanced sensor processing						
(U)	\$4,732	Develop affordable radar and radio frequency (RF) en technique generator technologies for combat aircraft t defense systems. Perform trade study analyses for tec study and transition analysis, begin hardware and soft warning and response capability. (In FY 2001, portio	nitter warning concepts and techniques. Develop affor- o increase survivability against advanced, integrated R hniques to defeat future threat radar guided missile sys- ware development, and hold preliminary design review ns of this effort were performed in PE 0603203F, Project	dable threat alert and jamming F, electro-optical, and infrared air tems. Complete requirements is for an advanced digital threat ect 69DF.)						
(U)	 \$991 Continue integrating Coherent Command, Control, Communications, Navigation, and Identification (C3NI) signal simulation capabilities into the IDAL. Upgrade the IDAL's C3NI equipment to the standards required for a joint survivability demonstration. 									
(U)	\$8,307	Total								
(U) (U)	<u>FY 2003 (\$ in Thou</u> \$3,296	sands) Develop and investigate offensive counter information networks. Complete hardware/software system integr Support Measures techniques to counter adversarial co Investigate and analyze various computer networks fo the selected high-speed, wideband data link targets	a warfare technologies to disrupt and deny hostile com- ation and conduct extensive ground tests to evaluate el ommunication and navigation systems. Continue the d r selection of the most viable threat. Design effective of	mand and control nodes and ectronic attack and Electronic etailed planning for the flight tests. countermeasures techniques against						
(U)	\$2,458	Integrate advanced sensor receiver and processing tec these technologies on mission applications. Conduct	hnologies, and conduct IDAL risk reduction evaluation DAL risk reduction evaluations and demonstrations to	s and demonstrations that focus evolve advanced sensor threat						
Р	roject 2432	Page	4 of 11 Pages	Exhibit R-2A (PE 0603270F)						

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) February 2002								
BUD0 03 -	GET ACTIVITY • Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat Techno	PROJECT logy 2432						
(U)	A. Mission Description Continued								
(U)	FY 2003 (\$ in Thousands) Continued								
(U)	 identification and location algorithms for real-time threat situation awareness. \$2,356 Develop affordable radar and radio frequency (RF) emitter warning concepts and techniques. Develop affordable threat alert and jamming techniques generator technologies for combat aircraft to increase survivability against advanced, integrated RF, electro-optical, and infrared air defense systems, including trade study analyses for techniques to defeat future threat radar guided missile systems. Continue hardware and software development through subsystem tests and early system integration for an advanced digital threat warning and response capability. 								
(U)	\$8,110 Total		thing and response cupuolity.						
(U)	<u>B. Project Change Summary</u> Not Applicable.								
(U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousa Related Activities: PE 0602204F, Aerospace Sensors. PE 0603203F, Advanced Aerospace Sensors. PE 0603500F, Multi-disciplinary Adv Space Tech. PE 0604270F, Electronic Warfare (EW) Development This project has been coordinated through the Reliance	ands) t. ce process to harmonize efforts and eliminate duplication.							
(U)	D. Acquisition Strategy Not Applicable.								
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.								
F	Project 2432	Page 5 of 11 Pages	Exhibit R-2A (PE 0603270F)						

BUDGET ACTIVITY PE NUMBER AND TITLE PR 03 - Advanced Technology Development 0603270F Electronic Combat Technology 43 COST (\$ in Thousands) FY 2001 Actual FY 2002 Estimate FY 2003 Estimate FY 2004 Estimate FY 2005 Estimate FY 2005 Estimate FY 2005 Estimate FY 2007 Estimate FY 2007 Esti		RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) DATE February 2002										
COST (\$ in Thousands)FY 2001 ActualFY 2002 EstimateFY 2003 EstimateFY 2004 EstimateFY 2006 EstimateFY 2007 EstimateCost to CompleteTotal431GRF Warning & Countermeasures Tech7,6728,4026,0096,9066,6187,8148,990ContinuingIn FY 2003, space unique tasks in this project will transfer to PE 0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate space unique activities.(U) A. Mission Description This project develops and demonstrates advanced technologies for radio frequency (RF) electronic combat (EC) suites to enhance the survivability of aerospace vehicles and to provide crew situational awareness. One major area addressed covers technologies for missile/threat warning, RF receivers, EC preprocessors, advanced sorting/preprocessing algorithms, and expert software for applications on existing and future EC systems. Another major technology area focuses on development and demonstration of subsystems and components for generating on-board/off-board RF countermeasure techniques. This includes the development electronic countermeasures (ECM) techniques as well as advanced ECM technologies such as antennas, power amplifiers, preamplifiers, etc.(U) FY 2001 (S in Thousands) (U)\$3,313Developed alfordable radar and RF emitter warning concepts and techniques. Evaluated a wideband digital receiver for alfordable elect suppression of enemy air defenses, surveillance, and reconnaissance). Integrated and chamber tested a multimode antenna to demonstra tenfold improvement in gain while providing a wide field of view and a low radar cross section.(U)\$2,953Developed aerospace platform self-protection	budg 03 -	JDGET ACTIVITYPE NUMBER AND TITLEPROJECT3 - Advanced Technology Development0603270F Electronic Combat Technology431G										
431G RF Warning & Countermeasures Tech 7,672 8,402 6,009 6,906 6,618 7,814 8,990 Continuing In FY 2003, space unique tasks in this project will transfer to PE 0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate space unique activities. Image: Commission Performs and Commendation PE 0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate space unique activities. (U) A.Mission Description This project develops and demonstrates advanced technologies for radio frequency (RF) electronic combat (EC) suites to enhance the survivability of aerospace vehicles and to provide crew situational awareness. One major area addressed covers technologies for missile/threat warning, RF receivers, EC preprocessors, advanced sorting/preprocessing algorithms, and expert software for applications on existing and future EC systems. Another major technology area focuses on development and demonstration of subsystems and components for generating on-board/off-board RF contermeasure techniques. This includes the developme electronic countermeasures (ECM) techniques as well as advanced ECM technologies such as antennas, power amplifiers, preamplifiers, etc. (U) \$1,406 Developed affordable radar and RF emitter warning concepts and techniques. Evaluated a wideband digital receiver for affordable elect support measures and radar warning receiver suites. (U) \$3,313 Developed wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance		COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
In FY 2003, space unique tasks in this project will transfer to PE 0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate space unique activities. (U) A. Mission Description This project develops and demonstrates advanced technologies for radio frequency (RF) electronic combat (EC) suites to enhance the survivability of aerospace vehicles and to provide crew situational awareness. One major area addressed covers technologies for missile/threat warning, RF receivers, EC preprocessors, advanced sorting/preprocessing algorithms, and expert software for applications on existing and future EC systems. Another major technology area focuses on development and demonstration of subsystems and components for generating on-board/off-board RF countermeasure techniques. This includes the development electronic countermeasures (ECM) techniques as well as advanced ECM technologies such as antennas, power amplifiers, preamplifiers, etc. (U) FY 2001 (\$ in Thousands) (U) \$1,406 Developed affordable radar and RF emitter warning concepts and techniques. Evaluated a wideband digital receiver for affordable elect support measures and radar warning receiver suites. (U) \$3,313 Developed wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance). Integrated and chamber tested a multimode antenna to demonstrate tenfold improvement in gain while providing a wide field of view and a low radar cross section. (U) \$2,953 Developed aerospace platform self-protection and support jamming	431G	RF Warning & Cou	untermeasures Tech	7,672	8,402	6,009	6,906	6,618	7,814	8,990	Continuing	
 (U) <u>A. Mission Description</u> This project develops and demonstrates advanced technologies for radio frequency (RF) electronic combat (EC) suites to enhance the survivability of aerospace vehicles and to provide crew situational awareness. One major area addressed covers technologies for missile/threat warning, RF receivers, EC preprocessors, advanced sorting/preprocessing algorithms, and expert software for applications on existing and future EC systems. Another major technology area focuses on development and demonstration of subsystems and components for generating on-board/off-board RF countermeasure techniques. This includes the development electronic countermeasures (ECM) techniques as well as advanced ECM technologies such as antennas, power amplifiers, preamplifiers, etc. (U) <u>FY 2001 (\$ in Thousands</u>) (U) \$1,406 Developed affordable radar and RF emitter warning concepts and techniques. Evaluated a wideband digital receiver for affordable electrosupport measures and radar warning receiver suites. (U) \$3,313 Developed wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance). Integrated and chamber tested a multimode antenna to demonstrate tenfold improvement in gain while providing a wide field of view and a low radar cross section. (U) \$2,953 Developed aerospace platform self-protection and support jamming technologies to counter advanced RF threats associated with current future air defense weapon systems. Conducted laboratory evaluations of EC techniques to increase aerospace system survivability. Con demonstration of a steerable high-power array. Designed and developed a flight-worthy brassboard for monopulse angle jamming integrity. 	In FY space	2003, space unique t unique activities.	tasks in this project will transfer	to PE 06035	500F, Projec	t 5034, in co	njunction w	ith the Space	e Commissio	on recommen	ndation to co	nsolidate all
 (U) <u>FY 2001 (\$ in Thousands</u>) (U) \$1,406 Developed affordable radar and RF emitter warning concepts and techniques. Evaluated a wideband digital receiver for affordable electrons support measures and radar warning receiver suites. (U) \$3,313 Developed wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance). Integrated and chamber tested a multimode antenna to demonstration for the infold improvement in gain while providing a wide field of view and a low radar cross section. (U) \$2,953 Developed aerospace platform self-protection and support jamming technologies to counter advanced RF threats associated with current future air defense weapon systems. Conducted laboratory evaluations of EC techniques to increase aerospace system survivability. Con demonstration of a steerable high-power array. Designed and developed a flight-worthy brassboard for monopulse angle jamming integration. 	(U)	A. Mission Description This project develops and demonstrates advanced technologies for radio frequency (RF) electronic combat (EC) suites to enhance the survivability of aerospace vehicles and to provide crew situational awareness. One major area addressed covers technologies for missile/threat warning, RF receivers, EC preprocessors, advanced sorting/preprocessing algorithms, and expert software for applications on existing and future EC systems. Another major technology area focuses on the development and demonstration of subsystems and components for generating on-board/off-board RF countermeasure techniques. This includes the development of electronic countermeasures (ECM) techniques as well as advanced ECM technologies such as antennas, power amplifiers, preamplifiers, etc.										
 (U) \$1,406 (U) \$1,406 (U) \$3,313 (U) \$3,313 (U) \$3,313 (U) Developed wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance). Integrated and chamber tested a multimode antenna to demonstration tenfold improvement in gain while providing a wide field of view and a low radar cross section. (U) \$2,953 (U) \$2,953 (U) Developed aerospace platform self-protection and support jamming technologies to counter advanced RF threats associated with current future air defense weapon systems. Conducted laboratory evaluations of EC techniques to increase aerospace system survivability. Con demonstration of a steerable high-power array. Designed and developed a flight-worthy brassboard for monopulse angle jamming integrated and developed a flight-worthy brassboard for monopulse angle jamming integrated and the steerable weapon systems. 	(U)	FY 2001 (\$ in Thous	sands)								a aa 1	
 (U) \$3,313 (U) \$3,313 (U) \$3,313 (U) \$3,313 (U) \$2,953 (U) \$2,953	(U)	\$1,406	Support measures and radar w	nd RF emitte varning recei	er warning co ver suites.	oncepts and	techniques.	Evaluated a	wideband d	igital receive	er for afforda	ble electronic
(U) \$2,953 Developed aerospace platform self-protection and support jamming technologies to counter advanced RF threats associated with current future air defense weapon systems. Conducted laboratory evaluations of EC techniques to increase aerospace system survivability. Con demonstration of a steerable high-power array. Designed and developed a flight-worthy brassboard for monopulse angle jamming integration of a steerable high-power array.	(U)	\$3,313	Developed wideband, multim suppression of enemy air defe- tenfold improvement in gain	ode, multifu enses, survei while provid	nction apert llance, and r ing a wide f	ures for elec econnaissan ield of view	tronic warfa ce). Integrat and a low ra	re applicatio ted and chan idar cross see	ns (i.e., threa nber tested a ction.	at detection, multimode	threat avoid antenna to d	ance, emonstrate a
electronic countermeasures. Built and demonstrated an advanced electronic protection breadboard.	(U)											
(U) \$7,672 Total	(U)	\$7,672	Total				r					
Project 431G Page 6 of 11 Pages Exhibit R-2A (PE 0603	Pi	roject 431G			Page	6 of 11 Pag	es			Ex	hibit R-2A (PE 0603270F)

BUDGET ACTIVITY PROJECT PROJECT 03 - Advanced Technology Development 0603270F Electronic Combat Technology 431G (U) A.Mission Description Continued 431G (U) A.Mission Description Continued 431G (U) P2 2002 (S in Thousands) 0 (U) S1.305 Develop Advanced Tactical Targeting Technology in conjunction with DARPA for Suppression of Enemy Air Defenses (SEAD). Integrate and flight test brassboard units that triangulate threat emitter positions and provide targeting for procision guided munitions. 0 (U) S779 Develop Widehand, multimode, multimication apertures for electronic wafare applications (i.e., threat detection, threat avoidance, SEAD, surveillance, and eveloping arcospace platform self- protection and support jamming technologies to counter advanced radio frequency threats associated with current and future aerospace weapon systems. Conduct field evaluation of advanced monopulse electronic countermeasure (ECM) brassboard system. Develop and test ECM techniques for aircraft against future RF threat systems. Jobinize, laboratory test, and field test electronic protection breadboard that will shield advanced radar systems against electronic attacks. (U) S8,402 Total Develop wideband, multimode, multifunction apertures for electronic wafare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and tectmely wide frequency rage with an instantareous bandwidt of between 41: 10: 10: 1.		RDT	&E BUDGET ITEM JUSTIFIC	CATION SHEET (R-2A Exhibit)	DATE Febru:	ary 2002
 (U) A.Mission Description Continued (U) FY 2002 (S in Thousands) (U) \$1,305 Develop Advanced Tactical Targeting Technology in conjunction with DARPA for Suppression of Enemy Air Defenses (SEAD). Integrate and flight test barsboard units that triangulate threat emitter positions and provide targeting for precision guided munitions. (U) \$779 Develop wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, SEAD, surveillance, and reconnaissance). Fabricate and test in the laboratory low-cost adaptive wideband conformal aperture sub-arrays consisting of structurally integrated, multiple polarization elements. (U) \$6,318 Study and initiate developing acrospace platform self-protection and support jamming technologies to counter advanced radio frequency threats associated with current and future acrospace weapon systems. Conduct field evaluation of advanced monopulse electronic countermeasure (ECM) brassboard system. Develop and test ECM techniques for aircraft against future RF threat systems. Optimize, laboratory test, and field test electronic protection breadboard that will shield advanced radar systems against electronic attacks. (U) \$1,934 Develop wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance). Demonstrate proof-of-concept for cost and weight reduction for adaptive, wideband conformal phased arrays that are integrated into potential unmanned acrospace platforms. These subarrays will have multiple polarization elements and perform over and extremely wide frequency range with an instantaneous bandwidth of between 4:1 to 10:1. (U) \$4,075 Complete study and continue developing and demonstrating acrospace eplatforms. These subarrays will have multiple polarization elements and perform over and extremely wide frequency	вирс 03 -	BET ACTIVITY Advanced Te	echnology Development	PE NUMBER AND TITLE 0603270F Electronic Combat Tech	nology	PROJECT 431G
 (U) <u>FY 2002 (\$ in Thousands</u>) (U) S1,305 Develop Advanced Tactical Targeting Technology in conjunction with DARPA for Suppression of Enemy Air Defenses (SEAD). Integrate and flight test brassboard units that triangulate threat emitter positions and provide targeting for precision guided munitions. (U) \$779 Develop wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, SEAD, surveillance, and reconnaissance). Fabricate and test in the laboratory low-cost adaptive wideband conformal aperture sub-arrays consisting of structurally integrated, multiple polarization elements. (U) \$6,318 Study and initiate developing aerospace platform self-protection and support jamming technologies to counter advanced radio frequency threats associated with current and future aerospace weapon systems. Conduct field evaluation of advanced monopulse electronic countermeasure (ECM) brassboard system. Develop and test ECM (echniques for aircraft against future RF threat systems. Optimize, laboratory test, and field test electronic protection breadboard that will shield advanced radar systems against electronic attacks. (U) \$8,402 Total (U) \$1,934 Develop wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance). Demonstrate proof-of-concept for cost and weight reduction for adaptive, wideband conformal phased arrays that are integrated into potential unmanned aerospace platforms. These subarrays will have multiple polarization elements associated with current and future aerospace platforms. These subarrays will have multiple polarization of enemy air defenses, surveillance, and reconnaissance). Demonstrate proof-of-concept for cost and weight reduction for adaptive, wideband elements and perform over and extremely wide frequency range with an instantaneous ba	(U)	A. Mission Desc	ription Continued			
 (U) \$1,305 Develop Advanced Tartical Targeting Technology in conjunction with DARPA for Suppression of Enemy Air Defenses (SEAD). Integrate and flight test brassboard units that triangulate threat emitter positions and provide targeting for precision guided munitions. (U) \$779 Develop wideband, multimetion apertures for electronic warfare applications (i.e., threat detection, threat avoidance, SEAD, surveillance, and reconnaissance). Fabricate and test in the laboratory low-cost adaptive wideband conformal aperture sub-arrays consisting of structurally integrated, multiple polarization elements. (U) \$6,318 Study and initiate developing aerospace platform self-protection and support jamming technologies to counter advanced radio frequency threats associated with current and future aerospace weapon systems. Conduct field evaluation of advanced monopulse electronic countermeasure (ECM) brassboard system. Develop and test ECM techniques for aircraft against future RF threat systems. Optimize, laboratory test, and field test electronic protection breadboard that will shield advanced radar systems against electronic attacks. (U) \$8,402 Total (U) <u>FY 2003 (S in Thousands)</u> (U) <u>S4,075 Complete study</u> and continue developing and demonstrating aerospace platforms. These subarrays will have multiple polarization elements and perform over and extremely wide frequency range with an instantaneous bandwidth of between 4:1 to 10:1. (U) <u>S4,075 Complete study</u> and continue developing and demonstrating aerospace platforms. First etchniques for aerospace platforms against future & RF countermeasure techniques for aerospace platforms against future & RF fortection and support jamming technologies and technology to protect our aerospace radar systems. Continue developing and evaluating innovative RF countermeasure techniques for aerospace platforms against future RF threat systems. Continue developing and performing laboratory and field test	(U)	FY 2002 (\$ in Th	ousands)			
(U) \$779 Develop wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, SEAD, surveillance, and reconnaissance). Fabricate and test in the laboratory low-cost adaptive wideband conformal aperture sub-arrays consisting of structurally integrated, multiple polarization elements. (U) \$6,318 Study and initiate developing aerospace platform self-protection and support jamming technologies to counter advanced radio frequency threats associated with current and future aerospace weapon systems. Conduct field evaluation of advanced monopulse electronic countermeasure (ECM) brassboard system. Develop and test ECM techniques for aircraft against future RF threat systems. Optimize, laboratory test, and field test electronic protection breadboard that will shield advanced radar systems against electronic attacks. (U) \$8,402 Total (U) \$1.934 Develop wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance). Demonstrate proof-concept for cost and weight reduction for adaptive, wideband conformal phased arays that are integrated into potential unmanned aerospace platforms. These subarrays will have multiple polarization elements and perform over and extremely wide frequency range with an instantaneous bandwidth of between 4:1 to 10:1. (U) \$4,075 Complete study and continue developing and demonstrating aerospace platforms and support jamming technologies and technologies to acounter advanced RF threat associated with current and future aerospace vaspace vaspace systems. Continue developing and performing laboratory and field tests of advanced electronic protection techniques and technology	(U)	\$1,305	Develop Advanced Tactical Targeting T	Fechnology in conjunction with DARPA for Suppression of Enem	y Air Defenses (SEA	D). Integrate
(U) \$6,318 Study and initiate developing acrospace platform self-protection and support jamming technologies to counter advanced radio frequency threats associated with current and future acrospace weapon systems. Conduct field evaluation of advanced monopulse electronic countermeasure (ECM) brassboard system. Develop and test ECM techniques for aircraft against future RF threat systems. Optimize, laboratory test, and field test electronic protection breadboard that will shield advanced radar systems against electronic attacks. (U) \$8,402 Total (U) \$1,934 Develop wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance). Demonstrate proof-of-concept for cost and weight reduction for adaptive, wideband conformal phased arrays that are integrated into potential unmanned aerospace platform self-protection and support jamming technologies and technologies to counter advanced RF threat systems. Continue developing and evaluating innovative RF countermeasure techniques for aerospace platforms against future RF threat systems. Continue developing and evaluating innovative RF countermeasure techniques for aerospace platforms against future RF threat systems. Continue developing and performing laboratory and field tests of advanced electronic protection techniques and technology to protect our aerospace radar systems. (U) \$6,009 Total (U) B. Project (Aange Summary Not Applicable. Project 431G	(U)	\$779	Develop wideband, multimode, multifu surveillance, and reconnaissance). Fabri	nction apertures for electronic warfare applications (i.e., threat det icate and test in the laboratory low-cost adaptive wideband confor ation elements	ection, threat avoidar mal aperture sub-arra	nce, SEAD, ays consisting of
 (U) \$8,402 Total (U) <u>FY 2003 (\$ in Thousands)</u> (U) \$1,934 Develop wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance). Demonstrate proof-of-concept for cost and weight reduction for adaptive, wideband conformal phased arrays that are integrated into potential unmanned aerospace platforms. These subarrays will have multiple polarization elements and perform over and extremely wide frequency range with an instantaneous bandwidth of between 4:1 to 10:1. (U) \$4,075 Complete study and continue developing and demonstrating aerospace platforms self-protection and support jamming technologies and techniques to counter advanced RF threats associated with current and future aerospace weapon systems. Initiate developing next generation monopulse countermeasure systems. Continue developing and evaluating innovative RF countermeasure techniques for aerospace platforms against future RF threat systems. Continue developing and performing laboratory and field tests of advanced electronic protection techniques and technology to protect our aerospace radar systems. (U) \$6,009 Total (U) B.Project Change Summary Not Applicable. 	(U)	\$6,318	Study and initiate developing aerospace associated with current and future aeros (ECM) brassboard system. Develop and test electronic protection breadboard that	e platform self-protection and support jamming technologies to con- space weapon systems. Conduct field evaluation of advanced mon- d test ECM techniques for aircraft against future RF threat system at will shield advanced radar systems against electronic attacks.	inter advanced radio opulse electronic cou s. Optimize, laborato	frequency threats intermeasure ory test, and field
 (U) FY 2003 (\$ in Thousands) (U) \$1,934 Develop wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance). Demonstrate proof-of-concept for cost and weight reduction for adaptive, wideband conformal phased arrays that are integrated into potential unmanned aerospace platforms. These subarrays will have multiple polarization elements and perform over and extremely wide frequency range with an instantaneous bandwidth of between 4:1 to 10:1. (U) \$4,075 Complete study and continue developing and demonstrating aerospace platform self-protection and support jamming technologies and techniques to counter advanced RF threats associated with current and future aerospace weapon systems. Initiate developing next generation monopulse countermeasure systems. Continue developing and performing laboratory and field tests of advanced electronic protection techniques and technology to protect our aerospace radar systems. (U) \$6,009 Total (U) B.Project Change Summary Not Applicable. 	(U)	\$8,402	Total			
 (U) \$1,934 Develop wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance). Demonstrate proof-of-concept for cost and weight reduction for adaptive, wideband conformal phased arrays that are integrated into potential unmanned aerospace platforms. These subarrays will have multiple polarization elements and perform over and extremely wide frequency range with an instantaneous bandwidth of between 4:1 to 10:1. (U) \$4,075 Complete study and continue developing and demonstrating aerospace platform self-protection and support jamming technologies and techniques to counter advanced RF threats associated with current and future aerospace weapon systems. Initiate developing next generation monopulse countermeasure systems. Continue developing and performing laboratory and field tests of advanced electronic protection techniques and technology to protect our aerospace radar systems. (U) \$6,009 Total (U) B. Project Change Summary Not Applicable. 	(U)	<u>FY 2003 (\$ in Th</u>	ousands)			
 (U) \$4,075 Complete study and continue developing and demonstrating aerospace platform self-protection and support jamming technologies and techniques to counter advanced RF threats associated with current and future aerospace weapon systems. Initiate developing next generation monopulse countermeasure systems. Continue developing and evaluating innovative RF countermeasure techniques for aerospace platforms against future RF threat systems. Continue developing and performing laboratory and field tests of advanced electronic protection techniques and technology to protect our aerospace radar systems. (U) \$6,009 Total (U) B. Project Change Summary Not Applicable. 	(U)	\$1,934	Develop wideband, multimode, multifu of enemy air defenses, surveillance, and conformal phased arrays that are integra elements and perform over and extreme	nction apertures for electronic warfare applications (i.e., threat det d reconnaissance). Demonstrate proof-of-concept for cost and wei ated into potential unmanned aerospace platforms. These subarray ely wide frequency range with an instantaneous bandwidth of betw	ection, threat avoidar ght reduction for ada s will have multiple p een 4:1 to 10:1.	nce, suppression ptive, wideband polarization
 (U) \$6,009 Total (U) <u>B. Project Change Summary</u> Not Applicable. Project 431G Page 7 of 11 Pages Fxhibit R-2A (PE 0603270F) 	(U)	\$4,075	Complete study and continue developin techniques to counter advanced RF thre monopulse countermeasure systems. C against future RF threat systems. Conti and technology to protect our aerospace	ag and demonstrating aerospace platform self-protection and support eats associated with current and future aerospace weapon systems. Continue developing and evaluating innovative RF countermeasure inue developing and performing laboratory and field tests of adva e radar systems.	rt jamming technolog Initiate developing n techniques for aerosynced electronic prote	gies and next generation pace platforms oction techniques
(U) <u>B. Project Change Summary</u> Not Applicable. Project 431G Page 7 of 11 Pages Exhibit R-2A (PE 0603270F)	(U)	\$6,009	Total	-		
Project 431G Page 7 of 11 Pages Exhibit R-2A (PE 0603270F)	(U)	B. Project Chan Not Applicable.	<u>ge Summary</u>			
	P	roject 431G		Page 7 of 11 Pages	Exhibit R-2A	(PE 0603270F)

RDT&E BUDGET ITEM JUST	DATE February 2002										
BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat Techno	PROJECT logy 431G									
 (U) <u>C. Other Program Funding Summary (\$ in Thousands</u> (U) Related Activities: (U) PE 0602204F, Aerospace Sensors. (U) PE 0604270F, Electronic Warfare (EW) Development. (U) PE 0603500F, Multi-disciplinary Adv Space Tech. (U) PE 0604270N, EW Development. (U) This project has been coordinated through the Reliance provided threliance provided through the Reliance	s)										
(U) D. Acquisition Strategy Not Applicable.											
 (U) <u>E. Schedule Profile</u> (U) Not Applicable. 											
Project 431G	Page 8 of 11 Pages	Exhibit R-2A (PE 0603270F)									
	362										
	RDT8	E BUDGET ITEM JU	JSTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
---------------------	--	--	--------------------------------	---	--	--------------------------------	-------------------------------	--------------------------------	-------------------------------	--------------------------------	----------------------------------
BUDO 03 -	BET ACTIVITY Advanced Tec	chnology Development			PE NUMBER AND TITLE 0603270F Electronic Combat Techno					PROJECT 691X	
	COST (\$	} in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
691X	EO/IR Warning &	Countermeasures Tech	9,357	15,696	9,231	12,616	12,614	12,430	12,646	Continuing	
In FY all sp	In FY 2003, space unique tasks in this project will be transferred to PE 0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate all space unique tasks.										
(U)) <u>A. Mission Description</u> This project develops and demonstrates the advanced warning and countermeasure technologies required to negate electro-optical (EO), infrared (IR), and laser threats to aerospace platforms. Off-board (decoys and expendables) and on-board countermeasure technologies developed for aircraft self-protection will provide robust, affordable solutions for protection against IR missiles with autonomous seekers, multi-spectral threats, laser-guided weapons, and EO and IR tracking systems used to direct EO, IR, and radio frequency (RF) missiles.										
(U) (U)	<u>FY 2001 (\$ in Thou</u> \$3,859	<u>isands)</u> Developed on-board, closed- scenarios. Fabricated a fligh	loop, laser in t-worthy clo	frared count sed-loop IR	termeasures CM suite for	(IRCM) for a demonstration	large aircraf ion on large	t to defeat cu aircraft.	urrent and fu	ture IR miss	iles in multiple
(U)	\$1,193	Conducted in-house analyses countermeasure techniques for imaging IR missiles.	of current and or convention	nd future IR nal and imag	threat missi ing IR missi	les. Comple les. Designo	ted digital m ed combined	nodels of IR l effects exp	threat missil endables for	es. Simulate tactical airci	ed expendable aft to defeat
(U)	\$980	Developed aerospace laser w locating both high power (daz warning sensor technology to	arning senso zzle/damage	r technologi) and low po ify laser haz	es for timely wer (laser-g	alert to adva uided ordnar	anced laser ance) signals.	acquisition/tr Conducedt	racking sens laboratory e	ors, includin valuation of	g detecting and ability of laser
(U)	\$1,907	Developed EO and IR missile low-signature threats. Evaluation	e warning technologies	chnologies to ctral imagin	alert aircre	ws and aircra v for missile	aft self-prote warning an	ection systen d/or distribu	ns to the app ted aperture	roach of adv sensors.	anced,
(U)	\$1,418	Developed countermeasure to steering technologies to reduc	chnology to be weight an	defeat passi d drag of cou	ve EO/IR ai	rcraft trackir e subsystems	ng sensors an s.	nd ordnance	guidance. In	nvestigated g	imballess beam
(U)	\$9,357	Total									
Р	roject 691X			Page	9 of 11 Pag	es			Ex	hibit R-2A (PE 0603270F)
					363						

	RD	T&E BUDGET ITEM JUSTIFIC	CATION SHEET (R-2A Exhibit)	DATE February 2002							
BUDO 03 -	GET ACTIVITY	Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat Tech	PROJECT nology 691X							
(U)	A. Mission De	escription Continued									
(U)	FY 2002 (\$ in	Thousands)									
(U)	\$9,164 Develop on-board, closed-loop, laser infrared countermeasures (IRCM) for large aircraft to defeat current and future IR-guided missiles in multiple scenarios. Integrate and flight test closed-loop IRCM technology on large aircraft.										
(U)	 \$1,151 Conduct in-house analyses of current and future IR guided threat missiles. Complete evaluation of novel expendable countermeasure design concepts and dispense patterns to defeat conventional IR-guided and imaging antiaircraft IR missiles. Initiate development of expendable decoy technology suitable for peacekeeping operations which can be safely deployed at low altitudes over urban areas. 										
(U)	\$1,618	Develop aerospace laser warning sensor locating both high power (dazzle/damag technology for space situational awaren modules. Test and evaluate laser warnin eve/sensor protection on airborne platfo	r technologies for timely alert to advanced laser acquisition/trackir ge) and low power (laser-guided ordnance) signals. Continue deve ess. Complete design of radiometer module and initiate designing ng sensor components for aircrew protection. Design laser warnin orms.	ng sensors, including detecting and eloping laser warning sensor g geolocation and spectrometer ng sensor to provide cueing for							
(U)	\$1,829	Develop electro-optical (EO) and infrar- approach of advanced, low-signature the declaration times in heavy clutter enviro	ed (IR) missile warning technologies to alert aircrews and aircraft reats. Initiate developing multi-color warning technologies that in onments.	self-protection systems to the nprove threat detection and reduce							
(U)	\$1,934	Develop countermeasure technology to techniques for locating, identifying, and techniques on a 2km range.	defeat passive EO/IR aircraft tracking sensors and ordnance guida l countering conventional and advanced EO/IR tracking sensors. I	ance. Continue evaluating detection Field test the most promising							
(U)	\$15,696	Total									
(U)	FY 2003 (\$ in	Thousands)									
(U)	\$320	Develop on-board, closed-loop, laser IR flight tests of closed-loop IRCM techno	CM for large aircraft to defeat current and future IR-guided missi logy on large aircraft.	les in multiple scenarios. Complete							
(U)	\$1,604	Conduct in-house analyses of the vulner decoy technology suitable for peacekeep capabilities and vulnerabilities of imagi	rabilities of current infrared missile systems and future imaging in ping operations that can be safely deployed at low altitudes over un ng infrared sensors used for target acquisition.	frared sensors. Fabricate expendable rban areas. Acquire and assess							
(U)	\$2,949	Develop aerospace laser warning sensor locating both high power (dazzle/damag which can cue agile filter protection for	r technologies for timely alert to advanced laser acquisition/trackir ge) and low power (laser-guided ordnance) signals. Initiate design aircrew or sensor protection.	ng sensors, including detecting and a of airborne laser warning sensor							
Р	roject 691X		Page 10 of 11 Pages	Exhibit R-2A (PE 0603270F)							

	RDT&E BUDGET ITEM JUSTIFI	DATE February 2002		
BUD(03 ·	SET ACTIVITY • Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat Techno	PROJECT 691X	
(U)	A. Mission Description Continued			
(U) (U) (U)	FY 2003 (\$ in Thousands) Continued\$4,358Develop countermeasure technology to demonstration program to detect and co to counter sensors beyond kinematic la\$9,231Total	o defeat passive EO/IR aircraft tracking sensors and ordnance guidance ounter passive electro-optical and infrared tracking sensors. Complet aunch capability.	ce. Initiate advanced technology te preliminary design for a method	
(U)	B. Project Change Summary Not Applicable.			
(U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602204F, Aerospace Sensors. PE 0604270F, Electronic Warfare (EW) Development. PE 0603500F, Multi-disciplinary Adv Dev Space Tech. PE 0604270N, EW Development. PE 0603203F, Advanced Aerospace Sensors. This project has been coordinated through the Reliance proces	ss to harmonize efforts and eliminate duplication.		
(U)	D. Acquisition Strategy Not Applicable.			
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.			
F	roject 691X	Page 11 of 11 Pages	Exhibit R-2A (PE 0603270F)	

THIS PAGE INTENTIONALLY LEFT BLANK

PE TITLE: Space and Missile Rocket Propulsion

	RDT&E BUDGET ITEM J	DATE	DATE February 2002								
BUDGET ACTIVITY 03 - Advanced Technology Development					PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion						
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost	
	Total Program Element (PE) Cost	26,703	0	0	0	0	0	0	Continuing	TBD	
4373	Launch and Orbit Transfer Propulsion Technology	22,864	0	0	0	0	0	0	Continuing	TBD	
6340	Satellite Control and Maneuvering Propulsion Technology	3,839	0	0	0	0	0	0	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	

Note: In FY 2002, efforts transferred to PE 0603216F, Project 4922, in order to align projects with the Air Force Research Laboratory (AFRL) organization.

(U) <u>A. Mission Description</u>

This program develops and demonstrates advanced rocket propulsion and space launch technologies. It provides the technological steps necessary to transition the most promising rocket propulsion and space launch technologies to applications using full-scale, proof-of-principle demonstrations. The projects within this program are structured to support Air Force Space Command's and Air Combat Command's mission area requirements for space and missile technologies which include the goals established in the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program, a multi-agency/industry effort to focus the development of U.S. rocket propulsion technology. New and improved components will be integrated with the environmentally improved propellants developed in this program to create new propulsion systems for the next generation of launch vehicles and satellites. Anticipated technological advances in this program will improve the performance of expendable systems' payload capabilities by 21 percent and reduce the launch and operations and support (O&S) costs by 28 percent. In a reusable launch system, the anticipated improvements are an increase in payload capability of 170 percent and a reduction in launch and O&S costs of 79 percent. The advances in propulsion in this program result from the achievement of the 2010 goals of the IHPRPT program. The development of these technologies has been coordinated with National Aeronautics and Space Administration to eliminate duplication of efforts. The space launch and missile propulsion industry will leverage the technologies from this program to enhance the country's industrial competitiveness.

(U) <u>B. Budget Activity Justification</u>

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.

Page 1 of 6 Pages

Exhibit R-2 (PE 0603302F)

	RDT&E BUDGET ITEM JUSTIFIC	CATION SHEET (R-2 Exhib	DATE Febru	DATE February 2002	
BUD	GET ACTIVITY	PE NUMBER AND TITLE	-		5
03 -	Advanced Technology Development	0603302F Space an	ket Propulsion		
(U)	C. Program Change Summary (\$ in Thousands)				
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	Total Cos
(U)	Previous President's Budget	27,776	0	0	
(U)	Appropriated Value	28,033	0		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions				
	b. Small Business Innovative Research	-658			
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram	-415			
	e. Rescissions	-257			
(U)	Adjustments to Budget Years Since FY 2002 PBR				
(U)	Current Budget Submit/FY 2003 PBR	26,703	0	0	TBD
	In FY 2002, remaining efforts in this PE will transfer to PE 0603	3216F, Project 4922.			
		Page 2 of 6 Pages		Exhibit R-2	(PE 0603302F)

	RDT&I	E BUDGET ITEM JU	STIFIC	ATION \$	SHEET	(R-2A E	xhibit)		DATE	Februa	nry 2002
BUD0 03 -	GET ACTIVITY - Advanced Tech	nnology Development			PE NUMBER AND TITLE 0603302F Space and Missile Rocket				ket Prop	oulsion	PROJECT 4373
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4373	Launch and Orbit 1	Fransfer Propulsion Technology	22,864	0	0	0	0	0	0	Continuing	TBD
Note	 te: In FY 2002, efforts transferred to PE 0603216F, Project 4922, in order to align projects with the Air Force Research Laboratory (AFRL) organization. <u>A. Mission Description</u> This project develops advanced and innovative, low-cost rocket turbomachinery and components, low-cost space and missile launch propulsion system manufacturing technologies, and advanced propellants. Characteristics such as environmental acceptability, affordability, reliability, reduced weight, reduced operation and launch costs, and increased life and performance of propulsion systems are emphasized in this project. Technological advances developed in this program will improve the performance of expendable systems' payload capabilities by 21% and reduce the launch and operations and support costs by 28%. The advances in propulsion in this program will result from the achievement of the 2010 goals of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program. 										
(U) (U) (U)	<u>FY 2001 (\$ in Thous</u> \$8,663 \$8,735	ands) Developed propulsion technol into advanced liquid test bed oxygen turbopump for integra and preburner components for prepared for hot fire testing of advanced liquid booster engir Developed propulsion technol achieved performance above p demonstrate solar thermal pro- propulsion technology. Conti-	logy for exis demonstrato ation into an r integration f pump assen e. Initiated logies for ex predicted lev pulsion tech nued progra	sting and futu r. Continued advanced lid into an adva mbly. Comp the design of tisting and fu- vels. Initiated mologies, su m to develop	ure launch vo d fabrication quid booster anced liquid bleted fabrica f advanced h ature upper s d turbopump ch as strut d p electric pro	ehicles. Cor and assemb engine. Cor booster engi ation of oxyg ydrocarbon tage and orb testing and evelopment opulsion syst	ntinued to de ly of combu- ntinued testi- ine. Installe gen and hydri- test bed engi- bit transfer ver- demonstrate and pointing tems for orb-	evelop turbon stion chamb ng of oxygen to oxygen tu rogen prebur ine. ehicles. Con d progress in and trackin it transfer by	nachinery co er and inject n and hydrog rbopump ass ner compon npleted thrus n hardware c g, for orbit t developing	components for cor. Continu- gen turbopur sembly into to ents for integ st chamber to operation Co- ransfer and to high-power	or integration ed fabrication of np assemblies test facility and gration into an esting and ontinued to maneuvering Hall thrusters
(U) (U)	\$1,750 \$3,716	microsat formation flying for Developed technologies for th advanced propellant, case, and Developed technologies for P unmanned missions. Defined	Air Force ir ne sustainme d nozzle tecl ulse Detona PDE perfor	naging missi ent of strateg hnologies an tion Engines mance requi	ions. ic systems. (d demonstra (PDE) to er rements. De	Continued th tes all cost a aable next ge esigned PDE	e Strategic S and performa eneration pro c engine and	Sustainment ince goals. opulsion opti key subsyste	Demonstrations for afforems includir	on program rdable access ag inlet, intal	which integrates s to space and ce valve, fuel
P	Project 4373			Page	e 3 of 6 Page	s			Ex	hibit R-2A	(PE 0603302F)

	RDT&E BUDGET ITEM JUSTIFICATION	SHEET (R-2A Exhibit)	DATE February 2002		
вирс 03 -	et activity Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket	Propulsion	PROJECT 4373	
(U)	A. Mission Description Continued				
(U) (U)	FY 2001 (\$ in Thousands) Continued injection, initiation, control, and thrust tube. Fabricat \$22,864 Total	ed components and evaluated fuel injection, initiation,	and cooling systems.		
(U) (U) (U)	FY 2002 (\$ in Thousands)\$0Effort moved to PE 0603216F, Project 4922.\$0Total				
(U) (U) (U)	FY 2003 (\$ in Thousands)\$0No activity.\$0Total				
(U)	B. Project Change Summary Not Applicable.				
(U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602203F, Aerospace Propulsion. PE 0602601F, Spacecraft Technology. PE 0603853F, Evolved Expendable Launch Vehicle Program. This project has been coordinated through the Reliance process to harmonize	efforts and eliminate duplication.			
(U)	D. Acquisition Strategy Not Applicable.				
(U) (U)	E. Schedule Profile Not Applicable.				
Р	roject 4373 Pag	e 4 of 6 Pages	Exhibit R-2A (PE 0	603302F)	
		270			

	RDT&	E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	iry 2002
BUDG 03 -	BET ACTIVITY Advanced Tecl	nnology Development			PE NUMBE 060330	R AND TITLE 2F Space	e and Mi	ssile Roo	ket Prop	oulsion	PROJECT 6340
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
6340	Satellite Control ar Technology	nd Maneuvering Propulsion	3,839	0	0	0	0	0	0	Continuing	TBD
Note	In FY 2002, efforts the	ransferred to PE 0603216F, Pro	ject 4922, in	order to alig	gn projects v	ith the Air I	Force Resear	rch Laborato	ory (AFRL) o	organization	
(-)	Chemical, electric, and solar rocket propulsion system technologies for station keeping and on-orbit maneuvering applications are developed in this project. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion systems, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy chemical propellants. The payoffs for the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program include a seven-year increase in satellite on-orbit time, a 50 percent increase in satellite maneuvering capability, a 25 percent reduction in orbit transfer operational costs, and a 15 percent increase in satellite payload.										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$419	ands) Developed propulsion system technologies that could be use satellites was downselected.	s for satellit ed for small	e formation satellite form	flying. Initi nation flying	ated develop . Using the	pment of ma se models, t	thematical n he optimum	nodels to add propulsion	dress differen system for us	nt propulsion se in small
(U)	\$325	Developed propulsion for sate fire tested the thruster in conj	ellite station	keeping and the power r	repositionin processing up	g. Initiated	brass board	level testing	of a pulsed	plasma thrus	ter system. Hot
(U)	\$3,095	Developed propulsion system (<100 kg) required for key Ai propulsion concepts from the	s for use in a r Force Space laboratory	satellite prop ce Command to the comm	oulsion. Initi d concepts. d ercial sector	ated develop initiated des	pment of pro ign of flight ne fabrication	pulsion syst hardware ar n of flight ha	em for fleet d began tecl ardware for 7	of Air Force nnology tran FechSat 21 s	small satellites sition of selected pacecraft.
(U)	\$3,839	Total									
(U)	FY 2002 (\$ in Thous	ands)									
(U)	\$0 \$0	Effort moved to PE 0603216	F, Project 49	22.							
P	roject 6340	i otai		Page	e 5 of 6 Page	S			Ex	hibit R-2A	(PE 0603302F)

	RDT&E BUDGET ITEM JUSTIFICATION S	HEET (R-2A Exhibit)	DATE February 2002	
BUDO 03 -	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket	Propulsion	PROJECT 6340
(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	A. Mission Description Continued FY 2003 (\$ in Thousands) \$0 No activity. \$0 Total B. Project Change Summary Not Applicable. C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602203F, Aerospace Propulsion. PE 0602601F, Spacecraft Technology. This project has been accordinated through the Paliance process to herrorize	offorts and aliminate duplication		
(U) (U) (U)	 D. Acquisition Strategy Not Applicable. E. Schedule Profile Not Applicable. 			
Р	Project 6340 Page	6 of 6 Pages	Exhibit R-2A (PE 0	603302F)
		372		

	RDT8	E BUDGET ITEM J	JSTIFIC	ATION	SHEET	(R-2 E)	chibit)		DATE	Februa	ry 2002
BUDG 03 -	BET ACTIVITY Advanced Tecl	nnology Development			PE NUMBE	r and title	stic Missi	ile Techn	ology		PROJECT 4091
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4091	Missile Electronics		22,249	1,188	0	0	0	0	0	0	TBD
	Quantity of RDT&E	Articles	0	0	0	0	0	0	0	0	0
In FY Fund (U)	 h FY 2003, this program anticipates receiving \$4.9 million from the Cost of War Transfer Account. These funds are not included in the FY 2003 Air Force baseline. unding will be used for ballistic missile technologies in support of the Technology for Sustainment of Strategic Systems program. U) <u>A. Mission Description</u> This program develops, integrates, and demonstrates advanced guidance, navigation, and control technologies for ballistic missiles, including upgrades of instrumentation for range safety. Note: This program was eliminated at the end of FY 1997; however, Congress added funds for Missile Technology Demonstration (MTD) flight testing and Radiation-Hardened Electronics in FY 1998, for Ballistic Missile Technology and Range Safety in FY 1999, for Ballistic Missile Technology 										
(U) (U)	FY 2001 (\$ in Thous \$16,066	ands) Developed technologies for th space and missile range instru- site-mobile GPS-INS range sa reduced operational costs whi range safety system at missile	ne integration mentation a afety system le providing launch sites	n of advance nd missile g to demonstr greater rang	ed Global Po uidance syst rate greatly i ge flexibility	sitioning Sy ems to meet mproved int and support	stem-Inertia more string egrity of mis ing launch o	l Navigation ent range sat ssile-tracking on demand.	System (GH fety requiren g data in all j Initiated cer	PS-INS) tech nents. Flight phases of flig tification of t	nologies into tested a ght at greatly the GPS-INS
(U)	\$1,439	range safety system at missile launch sites. Developed and demonstrated GPS-INS technologies to improve performance during all phases of flight to include ballistic reentry plasma blackout and jamming environments. These technologies will mitigate detrimental effects of reentry plasma and jamming on GPS-INS navigation performance. Transitioned current advanced GPS anti-jamming receiver, enhanced antenna architecture, and novel window material technologies to concern any demonstrated current demonstrated current (school price accentic) to new scenter and interval									
(U)	\$4,744	Developed and demonstrated extension programs. Advance concept exploration. Selected demonstrations that focus on sustainable less costly heat sh	advanced co ed concept e l affordable, evolutionary ield materia	ommon ballis xploration o existing adv vehicle des ls. Demonst	stic missile t f common b yanced-techn igns using ad rated revolu	echnologies allistic missi ologies dire dvanced con tionary mate	necessary for the technological technological technological tectly tied to un tectly tied to un tectly technological technologic	or the Air Fo gies will supp ser requirent the and flight , service life	orce and Nav port an analy nents. Cond t control tec prediction/c	y replaceme ysis of altern ucted concep hnologies/co component ag	nt and life atives for ot/technology mponents and ge out, and
Р	roject 4091			Page	e 1 of 3 Page	s			E	Exhibit R-2	(PE 0603311F)

	R	DT&E BUDGET ITEM JUSTIFIC	DATE Febru	ary 2002		
BUDO 03 -	GET ACTIVITY - Advanced	Technology Development	PE NUMBER AND TITLE 0603311F Ballistic Mi	ssile Techno	logy	PROJECT 4091
(U)	A. Mission De	escription Continued				
(U)	<u>FY 2001 (\$ in</u>	<u>Thousands) Continued</u> recovery techniques.				
(U)	\$22,249	Total				
(U) (U)	<u>FY 2002 (\$ in</u> \$990	<u>Thousands</u>) Develop technologies for the integration of and missile range instrumentation and miss robust technologies for the command and o flight conditions.	f advanced Global Position System-Inertial sile guidance systems to meet more stringen control system providing non-interfering, co	Navigation System t range safety requ ntinuous, two-way	n (GPS-INS) technolo irements. Develop a missile communicat	ogies into space nd demonstrate ion under all
(U)	\$124	Extend the acceptance and certification of and encompassing more severe launch con	qualified GPS-INS range safety technologie ditions.	es to meet launch-r	ange requirements in	more locations
(U)	\$74 \$1.188	Continue plasma technology development	efforts to mitigate GPS communication loss	through the reent	ry blackout phase of t	flight.
(U) (U) (U) (U)	<u>FY 2003 (\$ in</u> \$0 \$0 B. Budget Ac	<u>Thousands)</u> No Activity Total tivity Justification				
	This program system develo	is in Budget Activity 3, Advanced Technology Dev pments that have military utility and address warfig	elopment, since it develops and demonstrate hter needs.	es technologies for	existing system upg	rades and/or new
(U)	<u>C. Program (</u>	<u>Change Summary (\$ in Thousands)</u>				
(U) (U)	Previous Presi Appropriated	ident's Budget Value	<u>FY 2001</u> 22,789 23,000	<u>FY 2002</u> 0 1,200	<u>FY 2003</u> 0	<u>Total Cost</u>
(U)	Adjustments t a. Congression b. Small Busin c. Omnibus or	o Appropriated Value nal/General Reductions ness Innovative Research • Other Above Threshold Reprogram	-540	-12		
Р	Project 4091		Page 2 of 3 Pages		Exhibit R-2	2 (PE 0603311F)
			374			

RDT&E BUDGET ITEM JUSTIFICATION	DATE Febru	DATE February 2002		
BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603311F Ballistic	ology	PROJECT 4091	
 (U) <u>C. Program Change Summary (\$ in Thousands) Continued</u> d. Below Threshold Reprogram e. Rescissions 	<u>FY 2001</u> -211	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>
 (U) Adjustments to Budget Years Since FY 2002 PBR (U) Current Budget Submit/FY 2003 PBR 	22,249	0 1,188	0	TBD
(U) <u>Significant Program Changes:</u> Not Applicable.				
 (U) <u>D. Other Program Funding Summary (\$ in Thousands)</u> (U) Related Activities: (U) PE 0602204F, Aerospace Sensors. (U) This project has been coordinated through the Reliance process to harmonize 	efforts and eliminate duplica	ition.		
(U) <u>E. Acquisition Strategy</u> Not Applicable.				
 (U) <u>F. Schedule Profile</u> (U) Not Applicable. 				
Project 4091 Pag	e 3 of 3 Pages		Exhibit R-	2 (PE 0603311F)

THIS PAGE INTENTIONALLY LEFT BLANK

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE	Februa	ry 2002			
виро 03 -	BET ACTIVITY Advanced Tech	nology Development			PE NUMBE	r and title 3F Unma	anned Ai	r Vehicle	Dev/Der	no	PROJECT 5067
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5067	Unmanned Combat	Air Vehicle Tech Demo	0	20,952	18,000	0	0	0	0	Continuing	TBD
	Quantity of RDT&E	Articles	0	0	0	0	0	0	0	0	0
Note: (UCA this F (U)	 Iote: Beginning in FY 2002, ongoing Air Force technical efforts related to the Joint Air Force/Defense Advanced Research Projects Agency Unmanned Combat Air Vehicle UCAV) program have been consolidated into this PE per Congressional direction. Only the UCAV portions of the following PEs and Projects have been transferred into his PE: PE 0602202F, Project 7184; PE 0603203F, Project 665A; PE 0603211F, Project 4920; PE 0603601F, Project 670A; and PE 0603789F, Project 4072. U) <u>A. Mission Description</u> This program will develop, demonstrate, and transition advanced unarmed, unmanned aerial vehicle (UAV) and armed UCAV technologies. Flight testing to demonstrate integration of critical technologies, such as autonomous operations, inter-vehicle communications, and multi-vehicle flight operations, will improve the 										
(U) (U) (U)	performance and supp FY 2001 (\$ in Thousa \$0 \$0	portability of UAVs and UCAV ands) No Activity Total	7 S.								
(U) (U)	<u>FY 2002 (\$ in Thousa</u> \$11,754	ands) Develop and integrate critical operations. Prepare to conduc	technologie ct an end-to-	s that providend demons	le for autonc tration of the	mous operate mission uti	tions, inter-v lity of the U	ehicle comr CAV.	nunications,	multi-vehic	e flight
(U) (U)	 \$1,850 \$1,850 Complete the development of advanced fusion technology to evaluate the capability of UCAVs to operate in a Command, Control, Communication, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) data-rich environment as part of an integrated Command, Control, and Communications (C3) network. Demonstrate, through flight test, the concept of single distributed control by performing a hand off between a friendly area of operations controller and the area of responsibility controller (i.e., two different ground stations). Demonstrate, through flight test, the software elements for both the air vehicle and Mission Control Station required for the dynamic command and control of multiple vehicles by one controller. \$1,946 Continue the development and demonstration of technologies to support an affordable UCAV unit recurring flyaway goal in a C4ISR data-rich environment as part of an integrated C3 network. Demonstrate multi-vehicle flight operations: escort formations; collision avoidance; auto 										
P	roject 5067			Page	e 1 of 4 Page	s			E	Exhibit R-2	(PE 0603333F)

	R	DT&E BUDGET ITEM JUSTIFICAT	ION SHEET (R-2 Exhibit)	DATE February 2002					
вирс 03 -	GET ACTIVITY	Fechnology Development	PE NUMBER AND TITLE 0603333F Unmanned Air Vehicle Dev	PROJECT //Demo 5067					
(U)	A. Mission Description Continued								
(U)	FY 2002 (\$ in 7	housands) Continued							
(U)	\$2,668	routing; and dynamic re-tasking among others. Continue to develop and demonstrate both elect sensor capabilities on the unmanned combat air	Demonstrate multiple re-planned weapons drops. tro-optical and radio frequency technologies for both advance vehicle (UCAV).	ed technologies and complete					
(U)	\$1,400	Continue human systems technology support by and affordably perform the 21st century mission	y demonstrating remote operator control/interface, that can exist of defense suppression and tactical attack.	tend the capability to effectively					
(U)	\$1,334	Continue to integrate miniature munition conce	pts with UCAV and support integration and planning of a UC	CAV flight test.					
(U)	\$20,952	Total							
(U)	FY 2003 (\$ in 7	<u>'housands)</u>							
(U)	\$11,461	Complete development and integration of critic multi-vehicle flight operation. Complete an end	al technologies that provide for autonomous operations, inter d-to-end demonstration of the mission utility of the UCAV.	-vehicle communications, and					
(U)	\$2,699	Complete the development and demonstration of Control, Communications, Computer, Intelliger Command, Control, and Communication netwo routing; and dynamic re-tasking among others.	of technologies to support an affordable UCAV unit recurring nce, Survellance, and Reconnaissance (C4ISR) data-rich envi rk. Demonstrate multi-vehicle flight operations: escort forma Demonstrate multiple re-planned weapons drops.	flyaway goal in a Command, ronment as part of an integrated tions; collision avoidance; auto					
(U)	\$1,897	Complete development and demonstration of b UCAV.	oth electro-optical and radio frequency technologies for both	advanced technologies on the					
(U)	\$995	Complete human systems technology support b and affordably perform the 21st century mission	y demonstrating remote operator control/interface, that can e ns of defense suppression and tactical attack.	xtend the capability to effectively					
(U)	\$948	Complete integration of miniature munition co	ncepts with UCAV and complete UCAV flight test with mini	ature munition concepts.					
(U)	\$18,000	Total							
(U)	B. Budget Activity Justification This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for new unarmed, unmanned aerial vehicles and armed, UCAVs that have C4ISR or combat utility and address warfighter needs.								
Р	roject 5067		Page 2 of 4 Pages	Exhibit R-2 (PE 0603333F)					

	RDT&E BUDGET ITEM JUSTIFICATION	DATE Februa	DATE February 2002			
BUDO	GET ACTIVITY	PE NUMBER AN	ND TITLE			PROJECT
03 -	Advanced Technology Development	0603333F	Unmanneo	d Air Vehicle De	ev/Demo	5067
(U)	C. Program Change Summary (\$ in Thousands)					
			<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>
(U)	Previous President's Budget			0	0	
(U)	Appropriated Value			20,952		
(U)	Adjustments to Appropriated Value					
	a. Congressional/General Reductions					
	b. Small Business Innovative Research					
	c. Omnibus or Other Above Threshold Reprogram					
	d. Below Threshold Reprogram					
	e. Rescissions					
(U)	Adjustments to Budget Years Since FY 2002 PBR				18,000	
(U)	Current Budget Submit/FY 2003 PBR			20,952	18,000	TBD
(-)	Changes to this program since the previous President's Budget are due to Con Joint Air Force/Defense Advanced Research Projects Agency Unmanned Co	ngress directing mbat Air Vehicl	the consolidation e program into	on of Air Force Science a single Program Eler	ce and Technology f ment.	funding for the
(U)	D. Other Program Funding Summary (\$ in Thousands)					
(U)	PE 0602202F, Human Effectiveness.					
(U)	PE 0602201F, Aerospace Vehicle Technologies.					
(U)	PE 0603203F, Advanced Aerospace Sensors.					
(U)	PE 0603211F, Aerospace Technology Dev/Demo.					
(U)	PE 0603601F, Conventional Weapons.					
(U)	PE 0603789F, C3I Advanced Development.					
(U)	PE 0604731F, Unmanned Combat Air Vehicle.					
(U)	PE 0602702E, Tactical Technology.					
(U)	PE 0603285E, Advanced Aerospace Systems.					
(U)	PE 0603762E, Sensor and Guidance Technology.					
(U)	This project has been coordinated through the Reliance process to harmonize	efforts and elim	inate duplicatio	n.		
P	Project 5067 Page	e 3 of 4 Pages			Exhibit R-2	(PE 0603333F)
		379				· · ·

	RDT&E BUDGET ITEM JUSTIFICATIO	DATE February 2002					
BUD	GET ACTIVITY	PE NUMBER AND TITLE	PROJECT				
03 ·	- Advanced Technology Development	0603333F Unmanned Air Vehicle Dev	//Demo 5067				
(U)	E. Acquisition Strategy Not Applicable.						
(U) (U)	<u>F. Schedule Profile</u> Not Applicable.						
F	Project 5067 P	age 4 of 4 Pages	Exhibit R-2 (PE 0603333F)				
	380 UNCLASSIFIED						

	RDT&E BUDGET ITEM J	DATE	February 2002							
BUDGE 03 - /	DGET ACTIVITY PE NUMBER AND TITLE B - Advanced Technology Development 0603401F Advanced Spacecraft Technology									
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	61,171	60,932	42,315	53,323	54,364	61,987	63,206	Continuing	TBD
2181	Spacecraft Payloads	15,357	17,061	14,066	15,276	16,398	16,719	17,040	Continuing	TBD
3834	Integrated Space Technology Demonstrations	32,831	24,268	12,268	20,931	18,967	25,853	26,344	Continuing	TBD
4400	Space Systems Protection	5,302	6,050	2,798	3,075	3,545	3,617	3,685	Continuing	TBD
4938	Space Developmental Planning	0	4,980	0	0	0	0	0	0	TBD
5021	Space Systems Survivability	0	0	4,030	4,256	4,874	5,008	5,142	Continuing	TBD
682J	Spacecraft Vehicles	7,681	8,573	9,153	9,785	10,580	10,790	10,995	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	Continuing	TBD

Note: In FY 2002, efforts were transferred from PE 0603410F, Space Systems Environmental Interactions Technology, into Project 4400 in this PE, in order to align projects within the Air Force Research Laboratory organization. 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) <u>A. Mission Description</u>

This program develops, integrates, and demonstrates space technologies in the areas of spacecraft payloads, spacecraft protection, spacecraft and launch vehicles, and space systems survivability. The integrated space technologies are demonstrated by component or system level tests on the ground or in flight. Note: Congress added \$7.0 million in FY 2002 (\$6.0 million for Scorpius Low-Cost Launcher and \$1.0 million for Next Generation Hybrid Orbital Maneuver Vehicle).

Page 1 of 23 Pages Exhibit R-2 (PE 0603401F) 381 UNCLASSIFIED

	RDT&E BUDGET ITEM JUSTIFICATION	DATE Februa	DATE February 2002			
вирс 03 -	Advanced Technology Development	PE NUMBER AN	ID TITLE Advanced	Spacecraft Teo	chnology	
(U)	<u>B. Budget Activity Justification</u> This program is in Budget Activity 3, Advanced Technology Development, st system developments that have military utility and address warfighter needs.	ince it develops	and demonstra	tes technologies for e	xisting system upgra	ades and/or new
(U) (U) (U) (U)	C. Program Change Summary (\$ in Thousands) Previous President's Budget Appropriated Value Adjustments to Appropriated Value a. Congressional/General Reductions b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram		<u>FY 2001</u> 63,019 63,602 -1,498 -350	<u>FY 2002</u> 54,528 61,528 -596	<u>FY 2003</u> 50,373	<u>Total Cost</u>
(U) (U)	e. Rescissions Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR		-583 61,171	60,932	-8,058 42,315	TBD
(U)	Significant Program Changes: In FY 2003, decrease in funding due to the realignment of funding to higher p	priority S&T pro	grams and the	termination of Warfi	ghter-1 operations in	n Project 3834.
	Page	2 of 23 Pages			Exhibit R-2	(PE 0603401F)

BUDGE 03 - /	T ACTIVITY		RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)							Februa	ry 2002
	Advanced Tech	BUDGET ACTIVITYPE NUMBER AND TITLE03 - Advanced Technology Development0603401F Advanced							- Fechnolo	ogy	PROJECT 2181
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2181	Spacecraft Payload	ls	15,357	17,061	14,066	15,276	16,398	16,719	17,040	Continuing	TBD
(U)	<u>A. Mission Description</u> This project funds the development, demonstration, and evaluation of radiation-hardened space electronic hardware, and satellite control hardware and software for advanced satellite surveillance operations. 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 (ISCP) 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 DoD 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)	<u>FY 2001 (\$ in Thous:</u> \$8,311 \$1,428	ands) Developed advanced radiation memories, space-qualifiable, 1 micro-electro-mechanical syst technologies enable next gene and demonstrated radiation-ha system. Designed specification Demonstrated MEMS switchet technologies that enhance/ena electronics and initial plug-an Continued to develop intellige management technologies for real-time, reduce the time requ operations requirements. De control, cluster formation flyi began developing formation f	n-hardened 1 high density tems (MEM eration high ardened Pow ons, built, ar es for reconf able optical of d-play syste ent satellite s spacecraft of uired for dat monstrated i ng, and exec lying and or	nicroelectro advanced p S) compone performance ver PC. Inse ad demonstra igurable spa cross-links a m approach system techr constellation a collection intelligent sa cutive cluste bit determin	nic devices, ackaging tec nts and appli e, small, ligh ert Next Gene ated ground- ace electronic nd demonstr es for space. nologies for s s. These inte , processing, atellite softwar r management ation flight t	including sp hnology for cations, such tweight, effi- eration Space based compu- capplication ate the 400 M satellite cont lligent satell and dissemi are in the dis nt. Complet est software	ace data pro digital, anal h as switches cient, and re e Processor of uter based or s. Continue Megabit per rol, precision lite systems p nation, an de stributed-clu ed and demo	cessors and to og, and mixes and optical liable on-boa design and h in Improved S d the develop second data in spacecraft provide imprecease anon ster ground to onstrated enhe	ultra-high de components ard space ele ardware into Space Archit pment of pace transfer. De navigation, i roved capabi naly resoluti estbed for sa anced execu	ensity strateg ctronic devic s. These devices ctronic syste o flight demo eccture conce ckaging and eveloped reco formation fly ilities to more on time and atellite cluster software.	cically hardened ces, and vices and ems. Fabricated onstration ept. MEMS onfigurable ying, and cluster nitor satellites in ground er command and controller and
Pro	oject 2181			Page	e 3 of 23 Pag	es			Ex	hibit R-2A ((PE 0603401F)

	RD	DATE Fet	oruary 2002		
вирс 03 -	GET ACTIVITY Advanced	Fechnology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecr	aft Technology	PROJECT 2181
(U)	A. Mission Des	cription Continued			
(U) (U)	<u>FY 2001 (\$ in T</u> \$1,306	<u>'housands) Continued</u> Continued to develop modeling, simulation distributed satellite architecture payloads. T development systems engineering level tech for intelligent satellite systems testbeds. De tools across the broader modeling and simu World Vista's Global Awareness Virtual Te testbed. Completed exploitation of the hype assemble data images for target identification	, and analysis tools and data exploitation methodologie The modeling, simulation, and analysis (MS&A) tools inology trade off decisions for space-based surveillance elivered simulation architecture tools for satellite const lation space community. Demonstrated existing space estbed. Demonstrated MS&A software and tools in the erspectral imaging data received from the Fourier Trar on and image evaluation for commercial and military I	es for space-based survei provide data and validat ce missions/campaign lev tellation-level modeling surveillance simulation distributed satellite arch nsform Hyperspectral Im purposes.	illance systems and e research and vel assessments and and validate these s to support New hitecture simulation ager payload and
(U)	\$1,992	Developed advanced space infrared technol hot targets, as well as 'cold body' targets suc background detectors and focal plane arrays development of longer wavelength mercury focal plane arrays, and focal plane arrays w	ogy and hardened focal plane detector arrays to enable ch as decoys, satellites, and midcourse warheads. Desi s and higher temperature focal plane arrays with higher cadmium telluride focal plane arrays, higher operatin ith optimal background-limited performance for stress	 acquisition, tracking, ar igned low temperature, n r levels of radiation-hard g temperatures for mid-v sing space backgrounds. 	nd discrimination of nulti-color, and low lness. Began wavelength infrared
(U)	\$2,320	Developed satellite antenna technologies th antenna itself, and used antenna modules to affordability and capability of antenna mod Completed design of selected embedded-str requirement for minimizing mass and powe phased-array antenna tile. Completed data	at maximize the use of high density interconnects, emb create large, light space antennas. Satellite antenna te ules for space-based payload subsystems for Air Force cuctural transmit-receive electronics antenna modules. er by embedding lightweight electronics in the structure analysis on receive-only sub-antenna array data.	bedded the electronics di chnologies will be used surveillance and naviga Designed antenna modu e itself. Continued fabric	rectly onto the to improve tion efforts. Iles which address the cation of modular
(U)	\$15,357	Total			
(U) (U)	<u>FY 2002 (\$ in T</u> \$10,409	<u>'housands)</u> Develop spacecraft microelectronic devices memories, space-qualifiable, high density a applications. Design advanced general purp digital signal processors capable of perform memory elements into high density, low po	which will include radiation-hardened data processors dvanced packaging technology, and micro-electro-mea pose embedded processors capable of performing at 50 ning at 1 billion operations per second. Perform full-sc wer chips. Investigate integration of chalcogenide inte	s and ultra-high density s chanical systems compor 00 million instructions pe cale integration of chalco o other component applic	strategically hardened nents and er second. Design ogenide programmable cations. Extend
Р	roject 2181		Page 4 of 23 Pages	Exhibit R	-2A (PE 0603401F)
			384		

	RDT	DATE Febru	uary 2002						
вира 03 -	GET ACTIVITY	chnology Development	PE NUMBER AND TITLE 0603401F Advanced Space	craft Technology	PROJECT 2181				
(U)	A. Mission Descr	iption Continued							
(U)	FY 2002 (\$ in The	busands) Continued fabrication capability for application specific a micro-electro-mechanical systems switch miniaturization of optical cross-links for adv	c integrated circuit technology for upwards to eight box that will use discrete components with non-rad vanced packaging applications.	t million gate devices. Develo iation-hardened control circuit	p and demonstrate try. Investigate the				
(U)	 \$1,738 \$1,738 Continue to develop intelligent satellite system technologies for satellite control, precision navigation, formation flying, and cluster management technologies for spacecraft constellations. Develop flight-ready microsatellite cluster management software. Complete and demonstrate flight-ready microsatellite flying algorithms and initiate development of command and control and navigational capability to perform high-fidelity spacecraft proximity operations. Develop a virtual cluster control ground station capable of commanding and controlling multiple satellite clusters. Initiate development of automated planning and scheduling software and integration of distributed payload 								
(U)	\$858	Continue to develop modeling, simulation, a distributed satellite architecture payloads. E technology trades, systems engineering, and distributed signal processing to be validated	and analysis tools and data exploitation methodolog Build models for sparse, distributed aperture radio for design reviews for near-term flight test experiment against flight experiment and for systems analysis	gies for space-based surveilland requency (RF) system simulations. Build models of sparse ape	ce systems and ion to support erture RF				
(U)	\$2,527	Develop advanced space infrared technology targets, as well 'cold body' targets such as de low background detectors and focal plane ar development of longer wavelength mercury	y and hardened focal plane detector arrays to enable ecoys, satellites, and midcourse warheads. Fabricat rays, and higher temperature arrays with improved cadmium telluride focal plane arrays, higher opera-	e acquisition, tracking, and dis te and deliver low temperature radiation-hardness. Continue ating temperature mid-waveler	crimination of hot multi-color and iterative ngth infrared focal				
(U)	\$1,529	Develop satellite antenna technologies that i itself, and use antenna modules to create larg and capability of antenna modules for space embedded-structural transmit-receive electro and power by embedding lightweight electro into modules for performance characterizati	naximize the use of high density interconnects, em ge, light space antennas. Satellite antenna technolo -based payload subsystems for surveillance and nav onics antenna modules. Design antenna modules th onics in the structure. Complete fabrication of mod on.	bed the electronics directly on gies will be used to improve the vigation efforts. Fabricate select nat address requirements for m hular phased-array antenna tile	to the antenna he affordability ected inimizing mass s. Integrate tiles				
(U)	\$17,061	Total							
Р	roject 2181		Page 5 of 23 Pages	Exhibit R-2/	A (PE 0603401F)				
	385								

	RDT&E	February 2002							
budgi 03 -	ET ACTIVITY Advanced Tech	nology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Tech	PROJECT 2181					
(U)	A. Mission Descripti	on Continued							
(U) (U)	FY 2003 (\$ in Thousands) \$8,475 Develop spacecraft microelectronic devices, including radiation-hardened data processors and ultra-high density strategically hardened memories, space-qualifiable, high density advanced packaging technology, and micro-electro-mechanical systems (MEMS) components and applications. Perform simulations and validate designs of a general purpose embedded processor at 500 million instructions per second and digital signal processors at 1 billion operations per second. Fabricate and characterize high density, low power chips comprised of innovative chalcogenide programmable memory elements. Begin integration of chalcogenide into components such as field programmable logic and analog microelectronics. Develop macrocell libraries for application specific integrated circuit technology for up to eight million gate devices. Develop and demonstrate a MEMS-based switch box multi-chip module and associated heuristics for multi-switch box applications to smart-wiring manifolds.								
(U)	 \$1,797 Continue to develop intelligent satellite system technologies for satellite control, precision navigation, formation flying, and cluster management technologies for spacecraft constellations. Complete and deliver microsatellite cluster management software and integrate the distributed architecture test bed in preparation for a flight demonstration of collaborating three microsatellite constellation. Continue development of command and control and navigational capability for high fidelity spacecraft proximity operations. Continue to develop automated planning and scheduling software for multiple satellite clusters and the spacecraft and simulation data archiving and storage system. 								
(U)	\$929	Continue to develop modeling, simulation, and distributed satellite architecture payloads. Contechnology trades, systems engineering, and distributed signal processing to be validated a support the collaborating three microsatellite	nd analysis tools and data exploitation methodologies for space- omplete models for sparse, distributed aperture radio frequency design reviews for near-term flight test experiments. Complete against flight experiment and for systems analysis. Begin buildi constellation flight experiment.	based surveillance systems and (RF) system simulation to support models of sparse aperture RF ng mission operations center to					
(U)	 \$493 \$493 bevelop advanced space infrared technology and hardened focal plane detector arrays to enable acquisition, tracking, and discrimination of hot targets, as well 'cold body' targets such as decoys, satellites, and midcourse warheads. Demonstrate and characterize low temperature multicolor and low background detectors and focal plane arrays, and higher temperature arrays with improved radiation hardness. Fabricate and deliver longer wavelength mercury cadmium telluride focal plane arrays, higher operating temperature mid-wavelength infrared focal plane arrays, and focal plane arrays with optimal background-limited performance for stressing space backgrounds. Transition multicolor quantum well photodetector designs and other promising infrared technologies to large focal plane arrays. 								
(U)	\$2,372	Develop satellite antenna technologies which itself, and use antenna modules to create larg	a maximize the use of high density interconnects, embed the electric e, light space antennas. Test and integrate selected embedded-s	ctronics directly onto the antenna tructural transmit-receive					
Pr	oject 2181		Page 6 of 23 Pages	Exhibit R-2A (PE 0603401F)					

	RDT&E BUDGE	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)									
BUD0 03 -	GET ACTIVITY - Advanced Technology De	evelopment	PE NUMBER AND TITLE 0603401F Advanced Spacecraft	t Technology	PROJECT 2181						
(U)	A. Mission Description Continued	ļ									
(U) (U)	FY 2003 (\$ in Thousands) Continued electronics antenna modules with payloads for three microsatellite constellation space flight experiment. Test, integrate, and evaluate multi-beam, wide-bandwidth transmit-receive electronics antenna modules with payloads for possible airborne, multi-mode flight experiment. Fabricate and test antenna modules which address requirements for minimizing mass and power by embedding lightweight electronics in the structure. \$14,066 Total										
(U)	B. Project Change Summary Not Applicable.										
(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summ Related Activities: PE 0303601F, MILSTAR Satellite (PE 0305160F, Defense Meteorologi PE 0602601F, Spacecraft Technolog PE 0603211F, Ballistic Missile Tec PE 0603215C, Limited Defense Sys PE 0603218C, Research and Suppo PE 0603226E, Experimental Evalua PE 0604609F, Reliability and Main This project has been coordinated th	hary (\$ in Thousands) Communications System. cal Satellite Program (DMSP) gy. nnology. tem rt. tion of Major Innovative Tech tainability Technology Insertio trough the Reliance process to). hnologies. on Program (RAMTIP). o harmonize efforts and eliminate duplication.								
(U)	D. Acquisition Strategy Not Applicable.										
(U) (U)	E. Schedule Profile Not Applicable.										
F	Project 2181		Page 7 of 23 Pages	Exhibit R-2A	A (PE 0603401F)						

	RDT&I	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	nry 2002
виро 03 -	GET ACTIVITY • Advanced Tech	nnology Development			PE NUMBE 060340	r and title 1F Adva	nced Spa	acecraft	Technolo	PRO chnology 383	
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3834	Integrated Space T	echnology Demonstrations	32,831	24,268	12,268	20,931	18,967	25,853	26,344	Continuing	TBD
(U)	U) <u>A. Mission Description</u> The Integrated Space Technology Demonstration (ISTD) program is a series of advanced technology demonstrations designed to address mission needs by applying emerging technologies from the Air Force Research Laboratory, other Government laboratories, and industry. These technologies are integrated into system-level demonstrations that are used to test, evaluate, and validate the technologies in an operational environment. Note: In FY 2002, Congress added \$7.0 million (\$6.0 million for Scorpius Low-Cost Launcher and \$1.0 million for Next Generation Hybrid Orbital Maneuver Vehicle).										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$4,803	(\$ in Thousands) Continued to develop Warfighter-1, the first in the series of Integrated Space Technology Demonstration systems. Warfighter-1 was an inexpensive space-based hyperspectral imagery system intended for technology validation by a user in a tactical environment. Hyperspectral imaging sensors provide improved capabilities for the warfighter in target detection, terrain classification, and related surveillance applications. Launched Warfighter-1, however, the payload did not reach orbit due to failure of the launch vehicle.									
(U)	\$0	Develop and demonstrate pre- environments. These technol- navigation performance. Con demonstration of miniaturized	cision ballis ogies will m iduct reentry d jam-resista	tic missile na itigate the d plasma phy ant GPS rece	avigation tec etrimental ef sics characte ivers.	hnologies to fects of reen erization and	improve ac atry plasma a demonstrat	curacy durin and jamming ion planning	g reentry an on Global I , and contin	d in plasma Positioning S ue developm	and jamming System (GPS) lent and
(U)	\$3,242	Developed microsatellite (10- XSS microsatellite series. Stu hardware technologies and pr	100kg) tech udied bus re- oximity ope	nologies and quirements a rations sense	l integrated i and potential or package.	nicrosatellit designs. De	e technology eveloped gui	concepts. dance and n	Began desig avigation an	n of second s d maneuveri	satellite in the ng software and
(U)	\$1,860	Developed technologies for the Communications/Navigation Outage Forecasting System (C/NOFS) demonstration. C/NOFS will demonstrate the capability for forecasting outages to GPS navigation and satellite communications links, providing the warfighter with information on communications and navigation outages. This allows the preemptive use of backup systems and alternate links, which aids anomaly resolution, and facilitates mission/operations planning. Developed data processing unit. Verified payload interface and support spacecraft development and pre-planning of sensor suite integration and testing.									
(U)	\$6,287	Developed scalable booster te launching small payloads at s	echnologies ignificantly	tor low-cost reduced cost	launch vehio t. Developed	eles. Contin	ued develop 20,000-lb. tł	ment of the rust flight-v	Sprite orbita veight ablati	I demonstrat ve Sprite boo	oster engine.
Р	roject 3834			Page	8 of 23 Pag	es			Ex	hibit R-2A	(PE 0603401F)

	RD	T&E BUDGET ITEM JUSTIFIC	&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								
BUDO	GET ACTIVITY		PE NUMBER AND TITLE	PROJECT							
03 -	Advanced	Technology Development	0603401F Advanced Spacecraft Tecl	nology 3834							
(U)	A. Mission De	escription Continued									
(U)	FY 2001 (\$ in	Thousands) Continued									
		Developed and tested all composite liqu upper stage engine. Continued developed tank pressurization technology.	id oxygen propellant tank for the Sprite vehicle. Began systems ana ment and demonstration of hydroxyl ammonium nitrate/triethanol an	lysis for a Sprite 2,000-lb. thrust nine nitrate mixing gas generator							
(U)	\$4,837	Developed and demonstrated a low-cost Administration (NASA). Designed, fab	t, liquid propellant, expendable upper stage in a cooperative effort with ricated, and tested a flight ready integrated expendable upper stage.	th National Aeronautics and Space							
(U)	\$9,287	 Developed and demonstrated technologies for a military-unique, reusable, satellite bus and upper stage for the Military Spaceplane system. Developed advanced reusable rocket engine technologies for the Space Maneuver Vehicle (SMV) X-40 second tail number flight test article. Continued to develop technologies for the SMV, such as retractable solar arrays for longer on-orbit duration and fine attitude control system to enable proximity operations and precision sensor pointing, and applied the technologies to the X-37 demonstrator to improve military utility and leverage the NASA investment. 									
(U)	\$2,515	Developed and demonstrated propulsion affordable orbit transfer vehicle for insp heat exchanger to enable scaling to oper feedback control sensor and actuators. I sensor.	an and power technologies for solar thermal orbit transfer vehicle. The bection, reposition, and servicing of space assets above low earth orbi- rational size. Developed and built flight experiment scale test article Developed control system algorithms and simulations and ground test	ese technologies will enable an it. Developed and built modular of the inflatable concentrator and st algorithms with feedback control							
(U)	\$32,831	Total									
(U)	FY 2002 (\$ in	Thousands)									
(U)	\$594	Complete the Warfighter-1 technology of system for user validation in a tactical e development and commercial leveraging	demonstration effort, which was intended to provide an inexpensive nvironment. Complete final reports, detailing and evaluating lessons g efforts.	space-based hyperspectral imagery s learned from the Warfighter-1							
(U)	\$1,609	Develop autonomous microsatellite (10- Develop microsatellite technologies for	-100kg) technologies for an integrated, robust, flexible, modular mic non-cooperative, autonomous operational concept and mission plant	rosatellite technology concept.							
(U)	\$10,749	Design, develop, integrate and test an au non-cooperative, resident space object. microsatellite. Develop plans for launch	atonomous microsatellite to demonstrate integrated technology conce Perform design reviews and begin component/hardware fabrication h vehicle integration and safety analysis.	pts for operations around a for an autonomous operations							
(U)	\$4,383	Develop microsatellite system test scena	arios and design microsatellite hardware-in-the-loop, software simula	ations, and mission							
Р	roject 3834		Page 9 of 23 Pages	Exhibit R-2A (PE 0603401F)							

	RD	T&E BUDGET ITEM JUSTIFICA	DA	DATE February 2002						
BUDO										
03 -	Advanced	Technology Development	0603401F Advanced Space	cecraft Techno	ology 3834					
(U)	A. Mission Des	scription Continued								
(U)	FY 2002 (\$ in 7	<u>Chousands) Continued</u>								
(U)	\$5,942 Develop scalable booster technologies and a flight vehicle demonstrator for low-cost launch vehicles. Develop the detailed design and fabricate long-lead components for the SR-XM-2 suborbital flight vehicle. Perform post injector design modification developmental test firings and engine qualification firings for the 20,000 lb. thrust flight-weight ablative booster engine for the SR-XM-2.									
(U)	Develop technologies for a small, hybrid propulsion module capable of transferring selected Space Shuttle payloads to higher operational orbits after deployment. This orbital maneuvering capability will reduce both launch cost and risk, while enabling payloads to reach optimal orbit. Develop a conceptual design for the propulsion module that meets National Aeronautics and Space Administration safety and performance requirements. Design, fabricate, and ground test critical, high-risk propulsion module components, evaluating both performance and safety aspects.									
(U)	\$24,268	Total								
(U)	FY 2003 (\$ in 7	Thousands)								
(U)	\$1,873	Develop autonomous microsatellite (10-100 Perform mission operations concept trades uproximity operations.	(kg) technologies for an integrated, robust, flexible using hardware- software-in-the-loop simulations	le, modular microsa and mission planni	atellite technology concept. ing tools for non-cooperative					
(U)	\$8,908	Design, develop, integrate, and test autonon non-cooperative resident space object (RSO environmental test activities in preparation f evaluation.	nous microsatellite to demonstrate integrated tech)). Complete component development and begin for launch and operations. Perform final launch v	nnology concepts fo system level integra vehicle safety analy	or operations around a ration, functional, and yes and ground test and					
(U)	\$1,487	Use microsatellite hardware-in-the-loop and around a non-cooperative RSO.	l software simulations to perform comprehensive	ground testing of the	he autonomous micro-satellite					
(U)	\$12,268	Total								
(U)	B. Project Cha Not Applicable	nge Summary								
P	roject 3834		Page 10 of 23 Pages		Exhibit R-2A (PE 0603401F)					
	-		200		· · /					

	RDT&E BUDGET ITEM JUSTIFIC	CATION SHEET (R-2A Exhibit)	DATE February 2002	
BUD0 03 ·	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Te	PROJEC echnology 3834	Т
(U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602601F, Spacecraft Technology. PE 0603605F, Advanced Weapons Technology. This project has been coordinated through the Reliance process	s to harmonize efforts and eliminate duplication.		
(U)	D. Acquisition Strategy Not Applicable.			
(U) (U)	E. Schedule Profile Not Applicable.			
F	Project 3834	Page 11 of 23 Pages	Exhibit R-2A (PE 0603401	F)
		391 UNCLASSIFIED		

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE	DATE February 2002	
вира 03 -	GET ACTIVITY • Advanced Tecl	nnology Development			PE NUMBE	r and title 1F Adva	nced Spa	acecraft	Technolo	ogy	PROJECT 4400
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4400	Space Systems Pr	otection	5,302	6,050	2,798	3,075	3,545	3,617	3,685	Continuing	TBD
Note Air F survi	Vote: In FY 2002, efforts were transferred from PE 0603410F, Space Systems Environmental Interactions Technology, into this project in order to align projects within the Air Force Research Laboratory organization. In FY 2003, selected efforts were transferred within this PE from this project into Project 5021 in order to focus on improving aurvivability of space systems in natural environments.										
(U)	A. Mission Description This project develops and demonstrates tools, instruments, and mitigation techniques required to assure operation of U.S. space assets in potentially hostile warfighting environments. The project performs assessments of critical components and subsystems, and evaluates susceptibility and vulnerability to radio frequency and laser threats. This project also develops technologies that mitigate identified vulnerabilities. Technologies are developed and demonstrated to support balanced satellite protection strategies for detecting, avoiding, and operating in a hostile space environment.										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$43	ands) Used multi-threat assessment Provides space platform desig of passive satellite counterme	tool to evalu gnees a rapic asures and a	uate space-band space-	ased electro- assessment t	optical sense ool for accu	or responses rate assessm	to various c ent of variou	andidate las	er counterme easures. Beg	easures. gan development
(U)	\$567	Continued to develop on-boar unintentional ground-based ra savings compared to individu	rd satellite w adio frequen al sensor pa	varning techr cy (RF) sign ckages.	nologies and als. Began of	tools to dete lesign of int	ect, geolocat egrated RF r	e, and chara eceiver/lase	cterize the re r sensor hard	eceipt of inte lware with w	ntional and reight and power
(U)	\$338	Developed RF threat warning identify design changes to op flight. Conducted assessment	receiver for timize perfo	a one-year s rmance, and s effects on s	space flight. incorporated atellite com	Completed l changes in conents and	RF receiver to receiver d systems.	data analysi lesign to red	is, evaluated uce perform	receiver per ance risk for	formance to the one-year
(U)	\$1,452	Developed and demonstrated technologies for the Miniature Satellite Threat Reporting System (MSTRS). MSTRS technologies enable detection of ground-based RF threats to satellites from a variety of space platforms. Demonstrated threat reporting package on shuttle flight STS-107. Designed, fabricated, and demonstrated miniaturized instantaneous frequency measurement unit, power divider circuits, and high frequency circuit interconnects.									
(U)	\$2,902	Developed spacecraft protection Developed the capability to a	ion technolo ssess hardwa	gies applical are/software	ble to comm threat susce	ercial and m ptibility and	ilitary space vulnerabilit	satellites to y and develo	assure operation operation of the second sec	ation of spac ogies to miti	e assets. gate identified
Р	roject 4400			Page	12 of 23 Pag	ges			Ex	hibit R-2A	(PE 0603401F)

	RD	T&E BUDGET ITEM JUSTIFICA	DATE February 2002								
вирс 03 -	GET ACTIVITY	Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Te	PROJECT Chnology 4400							
(U)	A. Mission De	scription Continued									
(U)	<u>FY 2001 (\$ in </u>	Thousands) Continued vulnerabilities. Developed and exercised m commercial satellite subsystems to multi-the case studies of existing and developing space	nodeling and simulation tools to extend the current understandin reat environments. Developed radio frequency (RF) and laser ce systems.	ng of susceptibility of different threat and effects models to evaluate							
(U)	\$5,302	Total									
(U)	FY 2002 (\$ in	Thousands)									
(U)	\$256	5256 Use multi-threat assessment tool to evaluate space-based electro-optical responses to various candidate RF and laser countermeasures. Add interface for analyzing RF and laser interaction effects on satellites. Add response models for satellite subsystems, such as communications, power, and inertial measurement units.									
(U)	\$2,065	Develop passive satellite countermeasures a experiments to determine effectiveness of fi communications antennas. Initiate evaluation preparation for space demonstrations. Initiation space systems operations.	and mitigation techniques for current and future threats to satell iltering the radio frequencies to allow only selected frequencies ons and ground-based demonstrations of visible and near-infra ate assessments of the impact of satellite self-protection and sit	ites. Conduct plasma shield to reach the satellite red laser protection techniques in uational awareness technologies on							
(U)	\$1,441	Develop sensors to specify and forecast con integration, launch, and on-orbit operations forecasting hazardous space conditions will Initiate integration of plasma sensor for the detect solar disturbances one to three days p detector for mission to map the dynamic rad	ditions in the space environment that degrade the operation of of instrumentation to improve space radiation hazard specifica improve space system designs and lifetime, and enhance opera Communications/Navigation Outage Forecasting System onto prior to Earth impact and complete initial on-orbit validation. Of diation belts and quantify hazards to space systems.	space-based systems. Support tion and forecasting. Specifying and utional capabilities for the warfighter. payload. Launch all-sky camera to Complete integration of relativistic							
(U)	\$996	Conduct collaborative experiments and deve surveillance systems. Develop preliminary from harsh charging environments. Initiate generation systems. Develop interface betw charging design tool.	elop tools to improve the survivability of advanced spacecraft p design of second-generation miniaturized charge control system conceptual design of an experiment to quantify the effects of s ween dynamic space plasma and meteor specification and forec	ower, communications, and n to autonomously protect satellites pace plasma on tethered power ast models and web-based spacecraft							
(U)	\$1,292	Develop technology to warn of spacecraft c environment on Department of Defense spa	harging, chemical contamination, and kinetic impact hazards a ce systems. Space environment hazard warnings minimize los	nd to mitigate the effect of the space s of space assets due to component							
Р	roject 4400		Page 13 of 23 Pages	Exhibit R-2A (PE 0603401F)							

	RD	T&E BUDGET ITEM JUSTIFIC	DATE Febru	DATE February 2002						
BUDO	GET ACTIVITY		PE NUMBER AND TITLE		PROJECT					
03 -	Advanced	lechnology Development	0603401F Advanced Spacecrat	it lechnology	4400					
(U)	A. Mission De	scription Continued								
(U) (U)	FY 2002 (\$ in 7	<u>Thousands) Continued</u> and system level failures and, when wide and high-energy radiation effects will sig validation of compact environment anon detailed design for miniaturized space en impact hazards. Complete ground tests electron beam space experiment to demo Total	ely deployed, provide global situational awareness of hazarc gnificantly improve space system reliability and availability naly sensor for geosynchronous and highly elliptic orbits an nvironment distributed anomaly resolution sensor for on-orb of particle enhancement and depletion technologies and beg onstrate the feasibility of satellite protection technologies.	ds. Control of spacecraft c and reduce operational co d transition to operational bit detection of space partic in conceptual design of ac	charging levels osts. Complete use. Develop cle, chemical, and ctive wave and					
	EV 2002 (\$ in '	Thousands)								
(U)	 <u>FY 2003 (\$ in Thousands)</u> \$432 Use multi-threat assessment tool to assess space-based electro-optical responses to various candidate radio frequency and laser countermeasures. Begin verification and accreditation of weapons effects satellite assessment tools, complete documentation for users, and continue to develop additional tools for eact lite assessment tools and acceletation and accreditation of weapons effects satellite assessment tools, complete documentation for users, and continue to develop additional tools for eact lite assessment tools. 									
(U)	\$1,587	Develop passive satellite countermeasur plasma shield to selectively filter the rad demonstration. Conduct design and trad technologies on space systems operation satellites whose peacetime mission woul optical sensors and systems.	es and mitigation techniques for current and future threats to lio frequencies reaching the satellite communications antenn le studies and analyses to determine the impact of satellite so is. Develop technologies to support automatic wartime depl ld be compromised by on-board protection systems. Investi	as satellites. Continue dever has; prepare for conceptual elf-protection and situation oyment of protection tech gate electronic protection	lopment of the l space nal awareness nologies for techniques for					
(U)	\$779	Develop and demonstrate visible and ner- visible and near-infrared laser protection	ar-infrared laser protection technologies. Continue evaluation techniques in preparation for space demonstrations.	ons and ground-based dem	onstrations of					
(U)	\$2,798	Total								
(U)	B. Project Cha Not Applicable	ange Summary								
Р	roject 4400		Page 14 of 23 Pages	Exhibit R-2A	(PE 0603401F)					

RDT&E BUDGET ITEM JUSTIFICAT	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)							
BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraf	t Technology	PROJECT 4400					
 (U) <u>C. Other Program Funding Summary (\$ in Thousands)</u> (U) Related Activities: (U) PE 0602102F, Materials. (U) PE 0602601F, Spacecraft Technology. (U) PE 0603605F, Advanced Weapons Technology. (U) This project has been coordinated through the Reliance process to have the relation of the relatio	armonize efforts and eliminate duplication.							
(U) <u>D. Acquisition Strategy</u> Not Applicable.								
 (U) <u>E. Schedule Profile</u> (U) Not Applicable. 								
Project 4400	Page 15 of 23 Pages	Exhibit R-2A	(PE 0603401F)					
	395 UNCLASSIFIED							

	RDT&E	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 2002	
вирс 03 -	GET ACTIVITY Advanced Tech	nology Development			PE NUMBE	r and title 1F Adva	nced Spa	acecraft	Technolo	PROJECT Inology 4938	
	COST (\$ in	Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4938	Space Development	tal Planning	0	4,980	0	0	0	0	0	0	TBD
(U)	A. Mission Description This project funds the developmental planning for military space technologies. The project focuses on the Pre-Milestone I systems engineering and integration, studies and analysis, concept development, and architecture efforts needed to transition technology into promising space concepts, capabilities, and systems. Of particular importance is the analysis work performed to link military technologies to mission needs through the strategy-to-task methodology of the Air Force modernization process (AFPD 10-14). Another key aspect of this project is the defining, refining, and demonstrating of select space concepts offering significant future military utility to the warfighter, especially those that integrate existing or planned capabilities from across the entire national space community. A key component of this program is the demonstration of future space capabilities for wargames, exercises, experiments, and demonstrations. This project also funds Modeling and Simulation tools and related infrastructure development that are necessary to conduct studies and provide analysis on future space concepts and capabilities.										
(U) (U) (U)	<u>FY 2001 (\$ in Thousa</u> \$0 \$0	<u>nds)</u> No Activity Total									
(U) (U)	<u>FY 2002 (\$ in Thousa</u> \$1,015	nds) Conduct concept developmen design solutions across the my performance/ effectiveness in	t on promisi yriad of spac puts to Air I	ng space con ce discipline Force Space	ncepts. Prod s. Functions Command's	lucts include include spa Optimizer o	comprehens ce concept d f Utility Too	sive, high-le lesign, cost e lkit model.	vel, integrate engineering,	ed and scient and measure	ifically sound of
(U) (U)	 \$1,186 \$1,027 \$1,027 Conduct continuing system-of-systems engineering and integration for promising space concepts. Defines and refines concepts offering significant military utility to the warfighter focusing on the integration of air and space capabilities. Supports systems security protection 										
(U)	\$963	measures for current and plan Develop capability to demons simulation models/tools to inc	ned capabili trate relation clude proces	ties across the stress the stress the stress tensor tens tensor tens tensor tenso tensor tensor tens	he national s ets, and effec sentation ha	pace commu ts of space a rdware and s	unity. assets on the software, mo	military can del database	npaign in Ai upgrades, a	r Force camp and networki	baign and theater ng and leased
Р	roject 4938			Page	16 of 23 Pag	ges			Ex	hibit R-2A	(PE 0603401F)

	RDT&E BUDGET ITEM JUSTIFICATION	SHEET (R-2A Exhibit)	DATE February 2002						
BUDO	GET ACTIVITY	PE NUMBER AND TITLE	PROJECT						
03 -	Advanced Technology Development	0603401F Advanced Spacecraft Tech	nology 4938						
(U)	A. Mission Description Continued								
(U)	FY 2002 (\$ in Thousands) Continued	d simulation conshility							
(U)	\$512 Develop and integrate architectural concepts addressi	ng technology transition opportunities against space mi	ssion deficiencies and needs.						
(U)	\$277 Decrease the time to transition innovative space technology to the warfighter by demonstrating promising future space capabilities in exercises, wargames experiments and demonstrations								
(U)	\$4,980 Total								
(U)	FY 2003 (\$ in Thousands)								
(U) (U)	\$0 No Activity \$0 Total								
(U)	<u>B. Project Change Summary</u> Not Applicable.								
(U) (U)	C. Other Program Funding Summary (\$ in Thousands) Not Applicable.								
(U)	D. Acquisition Strategy Not Applicable.								
(U) (U)	E. Schedule Profile Not Applicable.								
P	roject 4938 Page	17 of 23 Pages	Exhibit R-2A (PE 0603401F)						
		207							

	RDT&	E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	iry 2002
BUD(03 -	GET ACTIVITY • Advanced Tech	nnology Development			PE NUMBE 060340	r and title 1F Adva	nced Spa	acecraft ⁻	Technolo	hnology 50	
	COST (\$ ii	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5021	Space Systems Su	rvivability	0	0	4,030	4,256	4,874	5,008	5,142	Continuing	TBD
Note envii	: In FY 2003, efforts v conments.	were transferred within this PE	from Project	t 4400 into tl	nis project, i	n order to fo	cus on impro	oving surviv	ability of spa	ace systems	in natural
(U)	J) <u>A. Mission Description</u> This project develops and demonstrates technologies to improve space system survivability and reliability of current and future Department of Defense space systems that must continue operation despite natural space hazards. It develops and demonstrates cost-effective solutions to mitigate hazardous space environmental interactions including electrical charge buildup and electronics failures due to both single radiation events and long-term radiation doses.										
(U) (U) (U)	FY 2001 (\$ in Thousands) \$0 No Activity \$0 Total										
(U) (U) (U)	<u>FY 2002 (\$ in Thous</u> \$0 \$0	<u>ands)</u> No Activity Total									
(U) (U) (U)	 FY 2003 (\$ in Thousands) \$985 Develop sensors to specify and forecast conditions in the space environment that degrade the operation of space-based systems. Support integration, launch, and on-orbit operations of instrumentation to provide improved space radiation hazard specification and forecasting. Complete validation of solar disturbances forecasting algorithms using space-based all-sky camera. Launch relativistic electron and proton detector and demonstrate ability to perform on-orbit mapping of the dynamic radiation belts to quantify hazards to space systems. Begin conceptual design of advanced all-sky, white light camera for operational space weather forecasting system. \$1,004 Conduct collaborative experiments and develop tools to improve the survivability of advanced spacecraft power, communications, and surveillance systems. Complete design and begin fabrication design of second-generation miniaturized charge control system. Complete conceptual design of an experiment to quantify the effects of space plasma on tethered power generation systems and determine feasibility of a space flight test to demonstrate on-orbit electrical power generation. Complete interface between dynamic space plasma and meteor models 										
P	roject 5021			Page	18 of 23 Pag	ges			Ex	(hibit R-2A	(PE 0603401F)
					398						
	RDT&E BUDGET ITEM JUSTIFICATION S	HEET (R-2A Exhibit)	DATE February 2002								
--------------------------	---	---	----------------------------	--	--	--	--	--	--	--	--
BUD 03	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Tech	PROJECT 5021								
(U)	A. Mission Description Continued										
(U) (U)	 J) <u>FY 2003 (\$ in Thousands) Continued</u> J) \$2,041 Develop technology to warn of spacecraft charging, chemical contamination, and kinetic impact hazards and to mitigate the effect of the space environment on Department of Defense space systems. Develop data assimilation techniques to produce improved dynamic radiation belt models using data from a fleet of compact environment anomaly sensors. Begin fabrication of miniaturized space environment distributed anomaly resolution sensor for on-orbit detection of space particle, chemical, and impact hazards. Develop detailed design of active wave and electron beam space experiment to demonstrate the feasibility of satellite protection technologies. 										
(U)	\$4,030 Total										
(U)	<u>B. Project Change Summary</u> Not Applicable.										
(U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) PE 0602601F, Spacecraft Technology. This project has been coordinated through the Reliance process to harmonize et D. Acquisition Strategy	forts and eliminate duplication.									
	Not Applicable.										
(U) (U)	E. Schedule Profile Not Applicable.										
F	Project 5021 Page 19	0 of 23 Pages	Exhibit R-2A (PE 0603401F)								
		399									

	RDT&I	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 2002	
BUDO 03 -	GET ACTIVITY • Advanced Tech	nnology Development			PE NUMBE	r and title 1F Adva	nced Spa	acecraft	Technolo	ogy	PROJECT 682J
	COST (\$ in Thousands)			FY 2002 Estimate	Y 2002 FY 2003 FY 2004 FY 2005 FY 2000 stimate Estimate Estimate Estimate			FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
682J	Spacecraft Vehicle	s	7,681	8,573	9,153	9,785	10,580	10,790	10,995	Continuing	TBD
(U)	A. Mission Description This project develops and demonstrates compact, low-cost, spacecraft and launch vehicle power generation, storage, distribution, and thermal management technologies, including cryogenic cooling technologies. Power generation activities focus on lightweight, low-cost, low-volume, and survivable solar cell arrays. Energy storage work focuses on lightweight nickel hydrogen and sodium sulfur spacecraft batteries and flywheel energy storage systems for extended (five to ten year) satellite missions. The project's power distribution efforts focus on producing lightweight, high-efficiency, standardized power busses for use on future Air Force space programs.										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$1,863	 <u>'housands</u>) Developed and evaluated the performance of space conventional power generation technologies such as multi-junction solar cells, advanced thin film solar cells, lightweight flexible arrays of thin film solar cells, and radiation resistant solar cell modules. Continued development of lightweight flexible arrays of thin film solar cells and radiation resistant solar cell modules. Continued evaluation of 35% efficient 									
(U)	\$788	Developed innovative space c system which employs non-el technologies. Began microfly	conventional ectrochemic wheel deve	energy stor cal energy stor lopment.	age technolo orage. Conti	gies such as nued flywhe	the lightwei eel ground d	ght flywhee emonstration	l integrated j n and develo	power and at pment of fly	titude control wheel safety
(U)	\$1,055	Developed technologies for lo ranging from 10K to 150K.	ong-life, effi Completed 1	cient, low vi 0K model cr	bration, ligh vocooler.	tweight mec	hanical cryo	coolers for s	space applic	ations at tem	peratures
(U) (U)	\$1,254 \$2,721	Developed composites for launch vehicles and spacecraft structures, including grid stiffened launch vehicle shrouds and lightweight thermal protection structures for reusable launch vehicles, and for space applications, such as lightweight space antennas. Developed spacecraft to demonstrate multifunctional structures technologies. Composite and multi-functional structures will be lighter and more affordable, with improved functionality, reducing fabrication and launch costs and enabling applications such as large aperture sensing systems. Ground tested and characterized operational grid stiffened structure. Continued development of inflatable structures. Begin ground test of multi-functional structures. Developed full-scale secondary payload adapter structure for an expendable launch vehicle. Developed and demonstrated revolutionary spacecraft structural control and mechanisms technologies for on-orbit applications such as advanced high power solar array subsystems, sensitive payload isolation systems, and miniature payload isolation systems for sensors and									
Р	roject 682J			Page	20 of 23 Pag	ges			Ex	hibit R-2A	(PE 0603401F)

	RD	T&E BUDGET ITEM JUSTIFIC	DATE February 2002								
BUDG 03 -	BET ACTIVITY Advanced	Fechnology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Tech	PROJECT Anology 682J							
(U)	A. Mission Des	cription Continued									
(U)	FY 2001 (\$ in Thousands) Continued communications systems. Developed launch vibration isolation and primary and secondary payload isolation systems to meet specific launch vehicle requirements. These technologies will enhance platform stability, enable applications such as precision pointing and sensing, protect payloads on orbit and increase payload lifetime, reduce launch environment problems, decrease spacecraft weight, and reduce failures. Tested miniature vibration suppression systems. Developed smart passive payload isolation systems. Ground demonstrated active acoustic attenuation system. Flight demonstrated simplified low shock separation device.										
(U)	\$7,681	Total									
(U)	<u>FY 2002 (\$ in 7</u>	<u>Thousands)</u>									
(U)	\$1,990	Develop and evaluate performance of space solar cells, lightweight flexible solar cell a large, free-flying, lightweight, flexible, rac 12% efficient thin film solar cells into large	ce conventional power generation technologies such as multi-junct urrays, and radiation resistant solar cell modules. Ground demonstr diation resistant, array of thin film solar cells. Integrate 35% effici- ge modules. Begin integration into full arrays.	ion solar cells, advanced thin film rate deployment and operation of ent multi-junction solar cells and							
(U)	\$822	Develop space conventional energy storag Ground demonstrate integrated attitude co conceptual design; fabricate and test micro	e technologies such as the lightweight flywheel integrated power a ntrol and energy storage system. Evaluate feasibility of microflyw oflywheel components.	and attitude control system. wheel technology based on							
(U)	\$1,356	Develop technologies for long-life, efficie performance of 10K model cryocooler. E electronics. Begin development of high ca	nt, low vibration, lightweight mechanical cryocoolers for space ap Develop and deliver high efficiency multi-stage cryocooler with rac apacity multi-stage 10K cryocooler system for advanced space sur-	plications. Characterize liation-hardened control veillance and tracking sensor.							
(U)	 Begin development of high capacity multi-stage 10K cryocooler system for advanced space surveillance and tracking sensor. \$1,303 Develop composites for launch vehicle and spacecraft structures and space applications, such as launch vehicle shrouds, thermal protection structures, and space antennas. Develop spacecraft to demonstrate multi-functional structures technologies. Flight demonstrate grid stiffened shrouds and thermal protection structures. Complete development of inflatable support structures. Continue ground test of multi-functional structures. Initiate integration of power and thermal technologies into multi-functional structures. Ground test full-scale secondary payload adapter structure for an expendable launch vehicle. 										
(U)	\$3,102	Develop technologies for spacecraft struct subsystems, sensitive payload isolation sy- secondary payload isolation systems to me systems. Design operational active acoust	tural controls and mechanisms for on-orbit applications such as advised stems, and miniature payload isolation systems. Develop launch vet specific launch vehicle requirements. Ground demonstrate smattic attenuation system. Develop and ground demonstrate passive a	vanced high power solar array ibration isolation and primary and art passive payload isolation coustic attenuation system.							
Р	roject 682J		Page 21 of 23 Pages	Exhibit R-2A (PE 0603401F)							

	RDT	&E BUDGET ITEM JUSTIFIC	D	DATE February 2002								
BUDG			PE NUMBER AND TITLE		i ebidai y	PROJECT						
03 -	Advanced Te	echnology Development	0603401F Advanced Spacecraf	t Techn	nology	682J						
(U)	A. Mission Desci	ription Continued										
(U)	FY 2002 (\$ in Th	ousands) Continued Integrate low shock separation devices an deployment mechanisms Develop modul	d whole spacecraft vibration isolation systems. Develop at	itonomous	s satellite docking a	ınd						
(U)	\$8,573 Total											
(U)	FY 2003 (\$ in Thousands)											
(U)	 \$1,833 Develop and evaluate performance of space conventional power generation technologies such as multi-junction solar cells, advanced thin film solar cells, lightweight flexible solar cell arrays, and radiation resistant solar cell modules. Flight demonstrate deployment and operation of large, free-flying, lightweight, flexible, radiation resistant, array of thin film solar cells. Continue integration of 35% efficient multi-junction solar cells and 12% efficient thin film solar cells into full arrays. 											
(U)	\$925	Develop innovative space conventional er system. Flight demonstrate integrated atti	nergy storage technologies such as the lightweight flywhee itude control and energy storage system. Develop operatio	integrated	d power and attitud flywheel demonstra	e control tion system.						
(U)	\$1,386	Develop technologies for long-life, efficie of high capacity multi-stage cryocooler te sensors with larger focal planes and optics	ent, low vibration, lightweight mechanical cryocoolers for s chnologies to meet the needs of high resolution, space-base s.	pace applied infrared	ications. Continue l surveillance and tr	development racking						
(U)	\$1,324	Develop composites for launch vehicle an structures, and space antennas. Develop s grid stiffened structures. Fabricate multif	nd spacecraft structures and space applications, such as laur spacecraft to demonstrate multifunctional structures techno functional spacecraft bus for small satellites. Flight demonstrate er structure.	ich vehicle logies. Co strate full-s	e shrouds, thermal p omplete evaluation scale Evolved Expe	protection of operational endable						
(U)	\$3,685	 baunch Vehicle secondary payload adapter structure. bevelop technologies for spacecraft structural controls and mechanisms for on-orbit applications such as advanced high power solar array subsystems, sensitive payload isolation systems, and miniature payload isolation systems. Develop launch vibration isolation and primary and secondary payload isolation systems to meet specific launch vehicle requirements. Flight demonstrate smart passive payload isolation systems. Ground demonstrate operational active acoustic attenuation system. Flight demonstrate passive acoustic attenuation systems. Integrate low shock separation devices into multiple payload adapter. Ground demonstrate smart docking and deployment mechanisms. Continue development of modular vibration-isolating spacecraft transport container. 										
(U)	\$9,153	Total										
(U)	<u>B. Project Chan</u> Not Applicable.	<u>ge Summary</u>										
Р	roject 682J		Page 22 of 23 Pages		Exhibit R-2A (PI	E 0603401F)						

	RDT&E BUDGET ITEM JUSTIFICATION S	DATE February 2002									
BUD 03	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Tech	PROJECT								
(U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: 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 Reliance process to harmonize	efforts and eliminate duplication.									
(U)	D. Acquisition Strategy Not Applicable.										
(U) (U)	<i>E. Schedule Profile</i> Not Applicable.										
	Project 682J Page 2	23 of 23 Pages	Exhibit R-2A (PE 0603401F)								
		403	403								

THIS PAGE INTENTIONALLY LEFT BLANK

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)									DATE February 2002	
BUD0 03 -	BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT D3 - Advanced Technology Development 0603410F Space Systems Environmental Interactions 2822 Technology									PROJECT ons 2822	
	COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2822	Space Environmn	nental Impact Tests	3,240	0	0	0	0	0	0	Continuing	TBD
	Quantity of RDT&	E Articles	0	0	0	0	0	0	0	0	0
(U) (U) (U)	 (U) <u>A. Mission Description</u> This program develops and demonstrates technologies to improve the survivability and reliability of current and future DoD space systems. It develops and demonstrates cost-effective solutions to mitigate hazardous space environmental interactions including electrical charge buildup and electronics failures due to both single radiation events and long-term radiation doses. (U) <u>FY 2001 (\$ in Thousands)</u> (U) \$1,325 Completed ground testing of space environmental sensor for flight with the Communications/Navigation Outage Forecast System (C/NOFS). Supported integration, launch, and on-orbit operations of instrumentation to provide improved space radiation hazard specification and forecasting. Completed space test of plasma sensor prototype for C/NOFS spacecraft. Completed integration of space-based, all-sky camera to detect solar disturbances. Began integration of relativistic electron and proton detector for mission to map the dynamic radiation belts and quantify the hazards to space systems. (U) \$1,017 Advanced spacecraft survivability through collaborative experiments and development of design tools needed for advanced power										
(U) F	 communications, and surveillance systems. Completed web-based spacecraft charging design tool. Began analysis of miniaturized charge control system and space power tether system performance. U) \$898 Developed technology to warn of spacecraft charging, chemical contamination, and kinetic impact hazards to DoD and commercial spacecraft. Developed technologies to mitigate the effect of the space environment on DoD space systems. Technologies to control the level of spacecraft charging and high-energy radiation effects will significantly improve space system reliability and availability, reduce operational costs, and provide techniques to degrade hostile space assets. Continued compact environment anomaly sensor validation. Demonstrated new compact environment anomaly sensor capabilities for geosynchronous orbit environments on Air Force operational satellites. Began ground tests of global particle enhancement and depletion technologies. 										

	RDT&E BUDGET ITEM JUSTIFI	DATE Febru	DATE February 2002		
BUD(03 -	GET ACTIVITY • Advanced Technology Development	PE NUMBER AND TITLE 0603410F Space Sy Technology	stems Enviro	onmental Interact	PROJECT
(U)	A. Mission Description Continued				
(U) (U)	FY 2001 (\$ in Thousands) Continued\$3,240Total				
(U) (U) (U)	FY 2002 (\$ in Thousands)\$0No Activity\$0Total				
(U) (U) (U)	FY 2003 (\$ in Thousands)\$0No Activity\$0Total				
(U)	B. Budget Activity Justification This program is in Budget Activity 3, Advanced Technology Desystem developments that have military utility and address war	evelopment, since it develops and demonstr fighter needs.	ates technologies t	for existing system upg	ades and/or new
(U)	C. Program Change Summary (\$ in Thousands)				
(II)	Desite a Desition de Data des	<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>
(\mathbf{U})	Appropriated Value	3,381	0	0	
(U)	Adjustments to Appropriated Value a. Congressional/General Reductions	5,412			
	b. Small Business Innovative Researchc. Omnibus or Other Above Threshold Reprogram	-80			
	d. Below Threshold Reprogram	-61			
(T. 1)	e. Rescissions	-31	0		
(U)	Adjustments to Budget Years Since FY 2002 PBR	2.240	0	0	
(U)	Current Budget Submit/FY 2003 PBK	3,240	0	U	TBD
F	roject 2822	Page 2 of 3 Pages		Exhibit R-2	2 (PE 0603410F)
		406 UNCLASSIFIED			

	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 2002						
BUDG 03 -	BET ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE PROJECT 0603410F Space Systems Environmental Interactions 2822 Technology						
(U) (U)	C. Program Change Summary (\$ in Thousands) Continued Significant Program Changes: In FY 2002, in order to align projects within the Air Force Research Laborato Project 4400.	ory organization, all efforts in this Program Element we	ere transferred to PE 0603401F,					
(U) (U) (U) (U)	D. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602601F, Spacecraft Technology. This project has been coordinated through the Reliance process to harmonize	efforts and eliminate duplication.						
(U)	<u>E. Acquisition Strategy</u> Not Applicable.							
(U) (U)	F. Schedule Profile Not Applicable.							
Р	roject 2822 Page	3 of 3 Pages	Exhibit R-2 (PE 0603410F)					
		407						

THIS PAGE INTENTIONALLY LEFT BLANK

	RDT&E BUDGET ITEN	DATE	DATE February 2002							
виро 03 -	GET ACTIVITY - Advanced Technology Developme	ent		PE NUMBE	r and title 6F Trans	formatic	onal Wide	eband MI	LSATCO	PROJECT M A006
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
A006	Transformational Wideband MILSATCOM	0	0	195,000	435,000	436,000	194,000	0	0	0
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0
Note Wide users	Note: 0603436, Transformational Wideband MILSATCOM, 63A006, Transformation Wideband MILSATCOM PE was created in order to Transform the Advanced Wideband System (PEs 63845F and 33602F) to incorporate an accelerated schedule and capabilities such as laser communications and additional protection for tactical users based on the Transformational Communications Architecture study.									
	U) A. Mission Description Transformational Wideband MILSATCOM(TWM) provides an opportunity to transform the current Advanced Wideband MILSATCOM System (PE's 0603845F and 0303602F) TWM programs for an accelerated schedule and capabilities such as laser communications and additional protection for tactical users (all within the emerging Transformational Communications Architecture study). TWM will initiate in FY2003 an Advanced Wideband System (AWS) that incorporates interoperable laser communications and is designed to meet the needs of the defense and intelligence communities for wideband tactical, protected tactical, broadcast, and relay communications; plan for the first launch in FY 2009. This PE addresses only acceleration of the design of the first two satellites which are accounted for in PE0603845E and the additional capabilities (Acceleration of procurament effort is reflected in PE 0603845E).									
(U) (U) (U)	FY 2001 (\$ in Thousands)\$0No Activity\$0Total									
(U) (U) (U)	FY 2002 (\$ in Thousands)\$0No Activity\$0Total									
(U) (U) (U) (U)	FY 2003 (\$ in Thousands) \$5,000 Program Support. This New Start program is an effort to transform the current AWS by integrating laser communications into system development. \$20,000 Technical Support \$170,000 System Definition									
Р	Project A006		Page	e 1 of 3 Page	es			E	Exhibit R-2 (PE 0603436F)

	RDT&E BUDGET ITEM JUSTIFICATION	DATE Fobruary 2002				
				. ,	rebruary	
03 -	Advanced Technology Development	0603436F	Transform	ational Wideba	nd MILSATCOM	A006
(U)	A. Mission Description Continued					
(U) (U)	FY 2003 (\$ in Thousands) Continued\$195,000Total					
(U)	B. Budget Activity Justification Funding is in budget activity 3, Science and Technology, since this effort will incorporate laser communications.	l support the trai	nsformation of	the current Advanced	Wideband System in ord	ler to
(U)	C. Program Change Summary (\$ in Thousands)					
(U) (U) (U) (U) (U) (U)	Previous President's Budget Appropriated Value Adjustments to Appropriated Value a. Congressional/General Reductions b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram e. Rescissions Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR Significant Program Changes: FY 2003 funds added in order to begin the transformation of the current Adv	vanced Wideban	<u>FY 2001</u> d System.	<u>FY 2002</u>	<u>FY 2003</u> 195,000 195,000	<u>Total Cost</u> 1,260,000
(U) (U)	D. Other Program Funding Summary (\$ in Thousands) PE0603845F & PE0303602F contain the remaining funds for the Advanced W	Videband Progra	ım			
(U)	E. Acquisition Strategy Developing acquisition strategy during FY02 to add on-orbit laser comm capa currently available technology, use of advanced concept technology demonstr feasible.	ability. Expect to ations, etc. Anti	o conduct mark	et analysis to include of ing full and open comp	evaluating industrial cap petition to the maximum	ability, extent
Р	roject A006 Page	e 2 of 3 Pages			Exhibit R-2 (PE	0603436F)
		410				

RDT&E BUDGET ITEM JUSTIFI	DATE February	2002	
BUDGET ACTIVITY D3 - Advanced Technology Development	PE NUMBER AND TITLE 0603436F Transformatio	nal Wideband MILSATCOM	PROJECT A006
 F. Schedule Profile This effort provides for first launch in FY 2009. The Advanced Wideband System (AWS) will incorporate interconduction 	operable laser cross links.		
Project A006	Page 3 of 3 Pages	Exhibit R-2 (PE	0603436F)

THIS PAGE INTENTIONALLY LEFT BLANK

	RDT	&E BUDGET ITEM J	JSTIFIC	ATION	SHEET	(R-2 Ex	(hibit)		DATE	Februa	ry 2002
BUDO 03 -	GET ACTIVITY • Advanced Te	chnology Development			PE NUMBE	R AND TITLE	LANCE	SYSTEM	PROJECT 4868		
	COST ((\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4868	Maui Space Sur	veillance System	18,905	27,020	6,472	6,452	6,436	6,524	6,611	Continuing	TBD
	Quantity of RDT	&E Articles	0	0	0	0	0	0	0	0	0
(U)	A. Mission Description This program funds the operation and upgrading of the Maui Space Surveillance System (MSSS) in Hawaii. Note: In FY 2002, Congress added \$17.4 million for the MSSS and \$3.4 million for Pan-STARRS.										
(U) (U)	FY 2001 (\$ in Thousands) \$1,950 Enhanced operational and research utility of MSSS data products. Developed, analyzed, and tested non-imaging space object identification tools for the Advanced Electro-Optical System (AEOS) sensors. Conducted studies in the feasibility of the use of the laser guidestar, and in applications for active tracking. Continued atmospheric characterization and advanced imaging algorithm development to support real-time										
(U) (U)	\$10,785 \$3,857	Provided technical support to Conducted upgrades for MSS adaptive optics upgrades, sens	research, de S. Complet sor enhancer	evelopment, ted observat ments, and to	and operation ory control s ool developm	nal users and ystem upgra nent. Demon	d visiting ex des on the (nstrated AE around for t	perimenters).8 meter bea OS/MSSS er	using the M m director to hancements	SSS assets. elescope. Co through cha	ompleted tracterization
(U)	\$2,313	Supported the Near Earth Ast object identification efforts ar	eroid Tracki nd evaluation	ng mission and of MSSS s	and follow-u ystems to de	p role on AI tect smaller/	EOS and los	t satellite sea	rch. Contin	ued non-ima	ging space
(U)	\$18,905	Total									
(U)	FY 2002 (\$ in Tho	ousands)									
(U)	\$3,383	Enhance operational and research utility of MSSS data products to include thermal mapping of long-wave infrared imagery. Study the feasibility of daylight imaging and active tracking with AEOS to include effects on sensor performance and safety issues. Analyze satellite orientation data for detailed characterization of space reconnaissance threats. Optimize exploitation tools and data dissemination architecture.									
(U)	\$14,295	Provide technical support to r	Provide technical support to research, development, and operational users and visiting experimenters using the MSSS assets.								
(U)	\$3,944	Conduct and demonstrate AE	OS/MSSS u	pgrades and	enhancemer	ts. Comple	te the AEOS	S long-wave	infrared ima	iger upgrade	background
Р	roject 4868			Pag	e 1 of 3 Page	S			E	Exhibit R-2	(PE 0603444F)

	R	DT&E BUDGET ITEM JUSTIFICA	TION SHEET (R-2 Exhib	it)	DATE Februa	ry 2002				
виро 03 -	GET ACTIVITY	Technology Development	PE NUMBER AND TITLE 0603444F MAULSP	ACE SURVEILL	ANCE SYSTEM	PROJECT 4868				
(U)	A. Mission De	escription Continued								
(U)	FY 2002 (\$ in	<u>Thousands) Continued</u> subtraction effort by operationalizing the tes Upgrade radiometer to allow for simultaneou 1.6-meter telescope by replacing the tracking targets.	t code (algorithm) which will produce a us four-channel capability and increased g system. Improve the reliability of the	ccurate radiometric of processing speed. If observatory control s	lata, temperature maps, mprove resolution of th system to increase acqu	and imagery. e sensor on the isition rate of				
(U)	\$2,030	Continue follow-up role on Advanced Electric detect and characterize smaller/fainter objection	ro-Optical System (AEOS) and lost satel ts.	lite search and non-i	maging space object id	entification to				
(U)	\$3,368 Execute the Pan-STARRS effort. Define technical concept for execution of Pan-STARRS to include the development of advanced charged-coupled, devices (CCDs) to detect very-dim space objects up to the 24th magnitude, a telescope system that uses the CCD detectors, and the hardware/procedures to collect and display the data. Initiate data archiving to support future data collection									
(U)	\$27,020	Total								
(U) (U) (U) (U)	FY 2003 (\$ in Thousands) \$1,072 Enhance operational and research utility of the Maui Space Surveillance System (MSSS) data products. Develop improved exploitation tools and new data fusion techniques to provide real-time information and optimize system for small satellite data collection. \$4,232 Provide technical support to research, development, and operational users and visiting experimenters using the MSSS assets. \$1,168 Conduct upgrades for MSSS. Demonstrate AEOS/MSSS enhancements in daylight imaging to include partial daylight operations on the AEOS									
(U)	\$6,472	Total								
(U)	B. Budget Act This program i system develop	tivity Justification is in Budget Activity 3, Advanced Technology Devel pments that have military utility and address warfigh	opment, since it enables and demonstrat ter needs.	es technologies for e	existing system upgrade	s and/or new				
(U)	<u>C. Program C</u>	Change Summary (\$ in Thousands)								
(U) (U) (U)	Previous Presid Appropriated V Adjustments to a. Congression	dent's Budget Value o Appropriated Value nal/General Reductions	<u>FY 2001</u> 19,445 19,625	<u>FY 2002</u> 6,484 27,284 -264	<u>FY 2003</u> 6,488	<u>Total Cost</u>				
Р	roject 4868		Page 2 of 3 Pages		Exhibit R-2 (PE 0603444F)				
			414		· · · · · · · · · · · · · · · · · · ·					

	RDT&E BUDGET ITEM JUSTIFICATIO	DATE February	/ 2002		
BUD0 03 ·	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603444F MAUI SP	ACE SURVEIL	LANCE SYSTEM	PROJECT 4868
(U)	C. Program Change Summary (\$ in Thousands) Continued	<u>FY 2001</u>	<u>FY 2002</u>	FY 2003	<u>Total Cost</u>
(U) (U)	 b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram e. Rescissions Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR 	-461 -79 -180 18,905	27,020	-16 6,472	TBD
(U)	<u>Significant Program Changes:</u> Not Applicable.				
(U) (U) (U) (U) (U) (U) (U) (U)	 D. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602605F, Directed Energy Technology. PE 0603605F, Advanced Weapons Technology. PE 0602500F, Multi-Disciplinary Space Technology. PE 0603500F, Multi-Disciplinary Advanced Development Space Technology. PE 0603883C, Ballistic Missile Defense Boost Phase Segment. This project has been coordinated through the Reliance process to harmonic proce	ology. onize efforts and eliminate duplicat	tion.		
(U)	E. Acquisition Strategy Not Applicable.				
(U) (U)	F. Schedule Profile Not Applicable.				
F	Project 4868	Page 3 of 3 Pages		Exhibit R-2 (PI	E 0603444F)
		415			

THIS PAGE INTENTIONALLY LEFT BLANK

PE TITLE: MULTI-DISCIPLINARY ADV DEV SPACE TEC

	RDT&E BUDGET ITEM J	USTIFIC	CATION	SHEET	(R-2 E)	(hibit)		DATE	Februa	ary 2002
BUDGE ⁻ 03 - A	r ACTIVITY Advanced Technology Development		PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC							
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	0	0	50,538	45,417	52,216	50,381	52,203	Continuing	TBD
5031	Advanced Optics & Laser Space Tech	0	0	9,842	9,993	12,103	10,362	11,326	Continuing	TBD
5032	Advanced Space Materials	0	0	6,870	2,102	1,889	1,774	2,943	Continuing	TBD
5033	Rocket Propulsion Demonstration	0	0	26,370	29,169	30,734	31,141	31,547	Continuing	TBD
5034	Advanced Space Sensors	0	0	4,856	4,153	7,490	7,104	6,387	Continuing	TBD
5062	Advanced Structures for Space Vehicles	0	0	2,600	0	0	0	0	0	0
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: This is 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 will be 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.

(U) <u>A. Mission Description</u>

This program develops and demonstrates multi-disciplinary space technologies in four 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 develops and demonstrates 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 targeting and electronic counter-countermeasures for spacecraft

Page 1 of 13 Pages

Exhibit R-2 (PE 0603500F)

	RDT&E BUDGET ITEM JUSTIFICA	DATE Febru	February 2002			
BUDC 03 -	GET ACTIVITY • Advanced Technology Development	PE NUMBER A 0603500F TEC	ND TITLE MULTI-DI	SCIPLINARY A	DV DEV SPAC	E
(U)	<u>A. Mission Description Continued</u> applications.					
(U)	B. Budget Activity Justification This program is in Budget Activity 3, Advanced Technology Develo system developments that have a military utility and address warfigh	pment, since it develops ter needs.	s and demonstr	rates technologies for	existing system upgr	ades and/or new
(U)	<u>C. Program Change Summary (\$ in Thousands)</u>					
(U) (U) (U)	Previous President's Budget Appropriated Value Adjustments to Appropriated Value a. Congressional/General Reductions b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram e. Rescissions Adjustments to Budget Years Since FY 2002 PBR Current Budget Submit/FY 2003 PBR		<u>FY 2001</u> 0 0	<u>FY 2002</u> 0 0	<u>FY 2003</u> 0 50,538 50,538	<u>Total Cost</u> TBD
(U)	Significant Program Changes: This is a new PE, but not a New Start, resulting from the Space Com	mission recommendatio	on to consolida	te all space unique ad	ctivities.	100
		Page 2 of 13 Pages			Exhibit R-2	(PE 0603500F)
		418				

	RDT&	E BUDGET ITEM JU	STIFIC	ATION \$	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUD(03 -	BET ACTIVITY Advanced Tech	nnology Development			PE NUMBE 060350 TEC	R AND TITLE	FI-DISCIP	LINARY	ADV DE	V SPACE	PROJECT 5031
	COST (\$ ii	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5031	Advanced Optics &	Laser Space Tech	0	0	9,842	9,993	12,103	10,362	11,326	Continuing	TBD
Note recor	: In FY 2003, space un nmendation to consoli	nique tasks in PE 0603605F, Pr date all space unique activities.	ojects 3150	and 3647, w	ill be transfe	rred into this	s project in c	conjunction v	vith the Spa	ce Commissi	on
(U)	A. Mission Description This project provides for the demonstration and detailed assessment of space unique technologies needed for advanced optics and high energy laser weapons for space mission areas. Near-term focus is on ground-based lasers for the space control mission.										
(U) (U) (U)	<u>FY 2001 (\$ in Thous</u> \$0 \$0	<u>ands)</u> No Activity Total									
(U) (U) (U)	<u>FY 2002 (\$ in Thous</u> \$0 \$0	<u>ands)</u> No Activity Total									
(U) (U) (U)	 i) 50 10tal FY 2003 (\$ in Thousands) j) \$521 Develop optics technologies for very long-range laser beam projection, collection, and optical imaging with a space-based bifocal relay mirror. Continue design and development of brassboard laser beam control system utilizing innovative adaptive optics technology for advanced beam steering and aberration correction. Develop technology to demonstrate integration of various optical components scaled to a realistic relay mirror system. Perform theoretical analysis, modeling and simulation, and optical design of a relay mirror optical system, optimizing efficiency. Develop and build hardware associated with this task. j) \$126 Perform directed energy and space environment vulnerability assessments on satellites in support of national Space Control and Space Situational Awareness requirements. Provide sure-safe data to U.S. Space Command for the performance of Laser Clearinghouse functions. Fuse finite state models with other satellite data and observables to produce a more complete space situational awareness posture. j) \$9,195 Perform atmospheric compensation/beam control experiments from Starfire Optical Range 3.5-meter telescope for applications including event with experiment provide sure safe bifue to the perform being on the performance of the performation of the performation and the performance of the perform atmospheric compensation/beam control experiments from Starfire Optical Range 3.5-meter telescope for applications including event with the performance of the perform										
P	roject 5031	antisatenne weapons, relay m	moi system	s, saterine te Page	3 of 13 Pag	es	ingn-resolut		Ex	hibit R-2A (PE 0603500F)

	RDT&E	DATE February 2002		
вирс 03 -	BET ACTIVITY Advanced Techn	ology Development	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV TEC	PROJECT DEV SPACE 5031
(U) (U) (U)	A. Mission Description FY 2003 (\$ in Thousand 5 6 7 8 8 8 9,842	<u>a Continued</u> <u>ds) Continued</u> guidestar radiometry tests using sodium-wavelength la compensation system for low-power laser projection to high-accuracy active satellite tracking on 3.5m telescop to low-earth-orbit satellite (integrated beam control der Fotal	ser beacon. Design and begin integration of full apert o satellites on weapons-class beam director (3.5-meter pe with simultaneous compensated satellite imaging an monstration).	ure point-ahead atmospheric telescope). Demonstrate nd compensated laser projection to
(U)	B. Project Change Sur Not Applicable.	nmary		
(U) (U) (U) (U) (U) (U) (U)	C. Other Program Fur PE 0602500F, Multi-Die PE 0602605F, Directed PE 0603444F, Maui Spa PE 0603605F, Advance PE 0603883C, Ballistic This project has been co	ading Summary (\$ in Thousands) sciplinary Space Technology. Energy Technology. ace Surveillance System. d Weapons Technology. Missile Defense Boost Phase Segment. ordinated through the Reliance process to harmonize o	efforts and eliminate duplication.	
(U)	D. Acquisition Strategy Not Applicable.	Y		
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.			
Р	roject 5031	Page	4 of 13 Pages	Exhibit R-2A (PE 0603500F)

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE	February 2002	
BUDG 03 -	BET ACTIVITY Advanced Tech	nology Development			PE NUMBE 060350 TEC	R AND TITLE DF MULT	[I-DISCIP	PLINARY	ADV DE	V SPACE	PROJECT 5032
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5032	Advanced Space M	laterials	0	0	6,870	2,102	1,889	1,774	2,943	Continuing	TBD
Note: recor	: In FY 2003, space un nmendation to consolid	iique tasks in PE 0603112F, Pr date all space unique activities.	ojects 2100	and 3946, w	ill be transfe	rred into this	s project in c	conjunction v	with the Spa	ce Commiss	ion
(U) (U) (U)	A. Mission DescriptionThis project develops and demonstrates materials technologies for transition into Air Force space systems. The laser hardened materials project develops materials technologies for the broadband protection of space sensors from a variety of laser threats. The world laser market is rapidly expanding with easy export to any nation. Survivability solutions must account for a variety of lasers facing a mission. To harden systems against all potential lasers, a combination of approaches is required. The space materials transition task provides critical data for prospective users to make engineering decisions on both structural and non-structural materials for space. Reducing risk in materials technology improves the affordability, reliability, survivability, and operational performance of current and future space systems.FY 2001 (\$ in Thousands) \$0No Activity										
(U) (U) (U) (U)	\$0 <u>FY 2002 (\$ in Thous:</u> \$0 \$0	ands) No Activity Total									
(U) (U)	 FY 2003 (\$ in Thousands) \$1,559 Develop and demonstrate advanced materials and processing technologies for space vehicles and subsystems to provide enhanced surveillance capabilities, improved access to space, and improve the overall affordability of space vehicles. Complete the demonstration of improved material processes with increased yields for robust, high performance, and producible infrared detector materials. Continue efforts to validate and demonstrate materials and materials processing technologies to improve affordability of spacecraft components. Validate measured effects of space exposure on advanced material systems. \$1,411 Develop and demonstrate advanced materials technologies that enhance laser hardening of Air Force spacecraft sensors to ensure safety, survivability, and operability in a laser threat environment. Demonstrate hybrid optical limiters for the protection of mid wave infrared staring 										
Р	roject 5032			Page	5 of 13 Pag	es	*		- Ex	hibit R-2A	(PE 0603500F)

	RDT&	E BUDGET ITEM JUSTIFICATION S	HEET (R-2A Exhibit)	DATE February 2002
BUD 03	GET ACTIVITY - Advanced Tecl	nnology Development	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV TEC	PROJECT / DEV SPACE 5032
(U)	A. Mission Descript	ion Continued		
(U) (U)	<u>FY 2003 (\$ in Thous</u> \$3,900	ands) Continued focal plane arrays. Demonstrate hardened coating proc systems. Conduct tests of hardening solutions for critic tactical sensors. Identify and evaluate optical limiter m arrays. Identify coating materials and processes for filt Develop and demonstrate advanced materials and proc	ess for Rugate fixed-wavelength filters and optical sw cal space sensor designs and environments based on su aterials for the protection of near-infrared to short-wa ers and optical switches for long-wave infrared space essing technologies to enable revolutionary improvem	vitches for mid-wave infrared space uccessful approaches employed in ave infrared staring focal plane systems. nents in the performance of
(U)	\$6.870	airbreathing and rocket-based aerospace vehicles and v processing technologies for large, lightweight, potentia characterize ceramic and organic-based composite mat Total	veapons. Identify and evaluate cryogenic fluid compa- lly load bearing tank structures for airbreathing and re- erials for durable, very high temperature aerospace ve	tible material and affordable ocket-based vehicles. Evaluate and hicle and weapon leading edges.
(U)	<u>B. Project Change S</u> Not Applicable.	Summary		
(U) (U) (U) (U) (U)	C. Other Program H PE 0602102F, Mater PE 0602500F, Multi- PE 0603112F, Advar This project has been	Funding Summary (\$ in Thousands) als. Disciplinary Space Technology. aced Materials for Weapon Systems. coordinated through the Reliance process to harmonize of	fforts and eliminate duplication.	
(U)	D. Acquisition Strat Not Applicable.	egy		
(U) (U)	E. Schedule Profile Not Applicable.			
F	Project 5032	Page	5 of 13 Pages	Exhibit R-2A (PE 0603500F)

RDT&E BUDGET ITEM JU	JSTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ary 2002
BUDGET ACTIVITY 03 - Advanced Technology Development				PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV TEC					PROJECT 5033
COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5033 Rocket Propulsion Demonstration	0	0	26,370	29,169	30,734	31,141	31,547	Continuing	TBD

Note: In FY 2003, space unique tasks in PE 0603216F, Project 4922, will be transferred into this project in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

This project develops advanced and innovative low-cost rocket turbomachinery and components, low-cost space launch propulsion system technologies, and demonstrates advanced propellants for launch and orbit transfer propulsion. Characteristics such as environmental acceptability, affordability, reliability, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. This project also develops chemical, electrical, and solar rocket propulsion system technologies for stationkeeping and on-orbit maneuvering applications. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion systems, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy propellants. Technological advances developed in this program will improve the performance of expendable systems' payload capabilities by ~20 percent and reduce the launch and operations and support costs by ~30 percent. Technology advances will also lead to seven-year increase in satellite on-orbit time, a 50 percent increase in satellite maneuvering capability, a 25 percent reduction in orbit transfer operational costs, and a 15 percent increase in satellite payload. The projects in this program are part of the Integrated High Payoff Rocket Propulsion Technology program, a joint Department of Defense, National Aeronautics and Space Administration, and industry effort to focus rocket propulsion technology on national space launch needs.

- (U) <u>FY 2001 (\$ in Thousands)</u>
- (U) \$0 No Activity
- (U) \$0 Total
- (U) FY 2002 (\$ in Thousands)
- (U) \$0 No Activity
- (U) \$0 Total

Project 5033

Page 7 of 13 Pages

Exhibit R-2A (PE 0603500F)

BUDGET ACTIVITY PE NUMBER AND TITLE 03 - Advanced Technology Development 0603500F MULTI-DISCIPLINARY ADV DEV SPACE (U) A. Mission Description Continued (U) FV 2002 (this Three all b)	PROJECT 5033
(U) <u>A. Mission Description Continued</u>	
 (U) <u>FY 2003 (\$ in Thousands)</u> (U) \$12,032 Develop liquid rocket propulsion technology for current and future space launch vehicles. Initiate fabrication of turbopumps for integration of turbopumps for integration of turbopumps for integration. Commence testing in an educated hydrogerbop test had engine. 	ntegration
 (U) \$3,715 Develop solar thermal and solar electric propulsion technologies for existing and future upper stage and orbit transfer vehicles. C demonstrate solar thermal propulsion technologies, such as strut development and pointing and tracking, for orbit transfer and ma propulsion technology. Continue program to develop electric propulsion systems for orbit-transfer by developing high-power Ha capable of low-earth-orbit - geosynchronous-earth-orbit transfer. Initiate testing of the advanced small satellite propulsion demor develop microsatellite formation flying capability for Air Force imaging requirements. 	ontinue to neuvering Il thrusters astration to
 (U) \$3,711 Develop propellant technologies for the sustainment of strategic systems. Continue testing of the Post Boost Control System prog demonstrate component technologies with available materials to reduce hardware costs and maintain system performance. Continu Strategic Sustainment Demonstration program technologies that integrates advanced propellant, case, and nozzle technologies and demonstrates cost and performance goals. 	ram to ue testing d
 (U) \$412 Develop electric propulsion technologies for satellite formation flying, stationkeeping, and repositioning. Complete brass board I a pulsed plasma thruster system. Initiate hot fire testing of the thruster integrated with the power processing unit. Continue develop propulsion system for Air Force small satellites (<100kg) required for key Air Force Space Command concepts. Initiate acceptar verification testing of flight hardware for formation flying demonstration spacecraft. 	evel testing of opment of ce and
(U) \$6,500 Component level evaluation of reusable hydrocarbon boost technology to support rocket-based combined cycle engines. Component evaluated are consistent with Integrated High Payoff Rocket Propulsion Technology Phase II hydrocarbon boost demonstration in 2005-2006. Determines rocket component technology to be integrated into future combined cycle engine development, as well as engine components for highly reusable launch.	ents to be FYs s hydrocarbon
(U) \$26,370 Total	
(U) <u>B. Project Change Summary</u> Not Applicable.	
Project 5033Page 8 of 13 PagesExhibit R-2A (P	E 0603500F)

BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT 0603500F MULTI-DISCIPLINARY ADV DEV SPACE 5033 TEC TEC 5033		RDT&E BUDGET ITEM JUSTIFICATION S	DATE February 2002	
U) C. Other Program Funding Summary (\$ in Thousands) (1) PE 0602102F, Materials. (1) PE 0602300F, Acrospace Propulsion. (1) PE 0602000F, Multi-Disciplinary Space Technology. (1) PE 060210AP, Mover Projection Advanced Technology. (1) PE 0603210F, Aerospace Propulsion Power Technology. (1) PE 0603210F, Aerospace Propulsion Power Technology. (1) PE 0603210F, Aerospace Propulsion Power Technology. (1) PE 06032316, Power Projection Advanced Technology. (1) PE 06032316, Power Projection Power Technology. (1) PE 06032316, Evolution Power Technology. (1) D. Acquisition Strategy Not Applicable. (1) E. Schedule Profile (1) Not Applicable. (2) Not Applicable. (2) Page 9 of 13 Pages Exhibit R-2A (PE 0603500F)	BUDGE 03 - /	T ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV TEC	PROJECT
Project 5033 Page 9 of 13 Pages Exhibit R-2A (PE 0603500F)	(U) <u>C</u> (U) P (U) P (U) P (U) P (U) P (U) P (U) T (U) <u>D</u> (U) <u>E</u> (U) N	 C. Other Program Funding Summary (\$ in Thousands) E 0602102F, Materials. E 0602203F, Aerospace Propulsion. E 0602500F, Multi-Disciplinary Space Technology. E 0602601F, Spacecraft Technology. E 0603114N, Power Projection Advanced Technology. E 0603216F, Aerospace Propulsion Power Technology. E 0603401F, Advanced Spacecraft Technology. E 0603401F, Advanced Spacecraft Technology. E 0603853F, Evolved Expendable Launch Vehicle Program. This project has been coordinated through the Reliance process to harmonize of Acquisition Strategy Iot Applicable. C. Schedule Profile Iot Applicable. 	efforts and eliminate duplication.	
	Pro	pject 5033 Page	9 of 13 Pages	Exhibit R-2A (PE 0603500F)

	RDT&E	BUDGET ITEM JU	STIFIC	ATION \$	SHEET ((R-2A E	xhibit)		DATE	DATE February 2002	
BUDG 03 -	BET ACTIVITY Advanced Tech	nology Development			PE NUMBE 0603500 TEC	r and title DF MULT	FI-DISCIP	LINARY	ADV DE	V SPACE	PROJECT 5034
	COST (\$ in	Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5034	Advanced Space Se	ensors	0	0	4,856	4,153	7,490	7,104	6,387	Continuing	TBD
Note: the S	In FY 2003, space un pace Commission reco	ique tasks in PE 0603203F, Pr mmendation to consolidate all	oject 665A, space uniqu	and PE 0603 e activities.	270F, Proje	cts 431G and	d 691X, will	be transferr	ed into this	project in co	njunction with
(U)	A. Mission Description This project develops and demonstrates space sensor technologies, including radio frequency (RF) sensors, electro-optical sensors, laser warning sensors, targeting and attack radar sensors, and electronic counter-countermeasures (ECCM). By developing multi-function radar, laser, electronic combat (EC), and ECCM technologies for space applications, this project provides space platforms with the capability to precisely detect, track, and target air- and ground-based high-value, time-critical targets, while remaining invulnerable to hostile and natural threats.										
(U) (U) (U)	<u>FY 2001 (\$ in Thousa</u> \$0 \$0	<u>nds)</u> No Activity Total									
(U) (U) (U)	<u>FY 2002 (\$ in Thousa</u> \$0 \$0	<u>inds)</u> No Activity Total									
(U) (U) (U)	FY 2003 (\$ in Thousands) \$186 Develop a signature analysis capability to evaluate the physical/chemical origins of paint/camouflage thermal reflectance features, and to develop a forward predictive capability validated with empirical measurements. Perform chemical analyses and develop an enhanced surface scattering model. Develop and validate a baseline predictive signature prediction model for space qualified hyperspectral electro-optical sensors. \$991 Develop and demonstrate technologies to maximize Global Positioning System (GPS) jam resistance, positional accuracy, timing accuracy, and										
		exploitation techniques to imp technologies to operate in spa technology for improved asse	prove offens ce to provid ssment of G	ive and defe e precise tim PS anti-jam	nsive comba le, position, a technologies	t capabilities and velocity 3.	s. Design ad for multiple	lvanced M-C platforms.	Code technol Demonstrat	logies. Deve e virtual fligl	lop reference nt test
P	roject 5034			Page	10 of 13 Pag	ges			Ex	hibit R-2A (PE 0603500F)

	RDT&E	DATE February 2002						
BUDG 03 -	GET ACTIVITY Advanced Techn	ology Development	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV TEC	PROJECT JEV SPACE 5034				
(U)	A. Mission Description	Continued						
(U) (U)	FY 2003 (\$ in Thousand \$430 C d tt F	ls) Continued Develop and demonstrate advanced wide-band EC RF r igitization of the modern complex RF signal environm echniques will stress reconfigurability, modularity, inte rogrammable Gate Arrays. Initiate requirements analy	receiver encoding/pre-processing/sorting concepts and nent for applications in existing and future space EC s erconnectivity and affordability by using advanced dig ysis, and hardware and software designs of future space	d techniques to handle increasing ystems. These concepts and gital technologies, such as Field ce electronic combat systems.				
(U)	\$1,632	Complete study of and continue developing space-base	d support jamming technologies and techniques that v	vill counter advanced radio				
(U)	frequency threats. Continue developing and assessing physical requirements for applying these technologies in space unique environments. Complete design of space hardened processor, geo-location, and spectrometer modules. Develop space laser warning sensor technologies for timely alert to advanced laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser-guided ordnance) signals. Complete false alarm package hardware and begin integration onto flight platform. Complete false alarm test planning. Continue risk reduction analysis for space hardened geo-location, spectrometer, and processor modules. Initiate fabrication of space laser warning sensor modules.							
(U)	\$4,856	otal						
(U)	<u>B. Project Change Sun</u> Not Applicable.	<u>1mary</u>						
(U) (U) (U) (U) (U) (U)	C. Other Program Fun PE 0602204F, Aerospac PE 0602500F, Multi-Dis PE 0603203F, Advanced PE 0603270F, Electronic This project has been co	ding Summary (\$ in Thousands) e Sensors. ciplinary Space Technology. l Aerospace Sensors. c Combat Technology. ordinated through the Reliance process to harmonize e	fforts and eliminate duplication.					
(U)	D. Acquisition Strategy Not Applicable.							
(U) (U)	E. Schedule Profile Not Applicable.							
Р	roject 5034	Page 1	1 of 13 Pages	Exhibit R-2A (PE 0603500F)				

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)										Februa	ry 2002
BUDG 03 -	et activity Advanced Techi	nology Development			PE NUMBE 060350 TEC	R AND TITLE	[I-DISCIP	LINARY	ADV	DE\	/ SPACE	PROJECT 5062
	COST (\$ in	Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 20 Estim	007 nate	Cost to Complete	Total Cost
5062	Advanced Structures	for Space Vehicles	0	0	2,600	0	0	0		0	0	0
Note: be ad	This is a new PE, but r dressed in future budge	not a New Start, resulting from t activities.	the Space (Commission	recommend	ation to cons	olidate all s	pace unique	activiti	ies. O	utyear fund	ng profiles will
(U)	U) <u>A. Mission Description</u> This project identifies, develops, and demonstrates the technologies to enable advanced access-to-space aerospace vehicles that deliver revolutionary capability, operability, responsiveness, and cost effectiveness. Enabling technologies include thermal protection, structures, vehicle systems, configurations, aerodynamics, and controls. Technology demonstration includes multi-disciplinary system level integration of the enabling technologies											
(U) (U) (U)	<u>FY 2001 (\$ in Thousan</u> \$0 \$0	<u>nds)</u> No Activity Total										
(U) (U) (U)	<u>FY 2002 (\$ in Thousan</u> \$0 \$0	<u>nds)</u> No Activity Total										
(U) (U) (U)	 (U) FY 2003 (\$ in Thousands) (U) \$2,600 Develop the airframe and payload technologies required to enable next generation reusable access to space systems including the thermal protection, structural, configuration and vehicle and payload system technologies that enable aerospace vehicles to exhibit revolutionary capability, operability, responsiveness, and cost effectiveness. Investigate integration of the multidisciplinary technologies required to design and demonstrate these aerospace vehicle configurations such as materials, munitions, human effectiveness, and both rocket- and airbreathing-based hypersonic propulsion. (U) \$2,600 Total 											
(U)	<u>B. Project Change Su</u>	immary										
P	roject 5062			Page	12 of 13 Pag	ges				Exł	nibit R-2A (PE 0603500F)

	RDT&E BUDGET ITEM JUSTIFICA	DATE February 2002	
BUD 03	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY TEC	PROJECT ADV DEV SPACE 5062
(U) (U)	<u>C. Other Program Funding Summary (\$ in Thousands)</u> PE 0602500F, Multi-Disciplinary Space Technology		
(U)	<u>D. Acquisition Strategy</u> Not Applicable.		
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.		
F	Project 5062	Page 13 of 13 Pages	Exhibit R-2A (PE 0603500F)

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 2002	
BUDGET ACTIVITY 03 - Advanced Technology Developme	ent		PE NUMBE 060360	R AND TITLE	entional	Weapon	s Techno	ology	
COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	21,398	39,729	38,001	25,017	22,859	23,312	23,765	Continuing	TBD
670A Ordnance Technology	21,398	12,399	18,158	15,967	14,111	14,380	14,650	Continuing	TBD
670B Guidance Technology	0	27,330	19,843	9,050	8,748	8,932	9,115	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0
 Note: In FY 2001, Project 670A and Project 670B we the different technology development and demonstration (U) <u>A. Mission Description</u> This program develops, demonstrates, and integrojects: (1) development of conventional ordna including seekers, pavigation and control, and set and s	pre combined interior programs. Trates ordnance a ance technologies	a single pro nd advanced s including v In FY 2002.	guidance te varheads, fuz Congress ac	2002, Project 20	ct 670B was for air-launch losives; and llion to the I	separated fr ned conventi (2) developn .ow-Cost Au	om Project (onal weapon nent of adva	670A for cla ns. The prog nced guidan Attack Syster	rity in describing gram includes two ce technologies m (LOCAAS)

(U) <u>B. Budget Activity Justification</u>

program.

This program is in the 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) <u>C. Program Change Summary (\$ in Thousands)</u>

			<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>
(U)	Previous President's Budget		22,523	37,617	23,827	
(U)	Appropriated Value		22,731	40,117		
(U)	Adjustments to Appropriated Value					
	a. Congressional/General Reductions			-388		
		Page 1 of 9 Pages			Exhibit R-	2 (PE 0603601F)

	RDT&E BUDGET ITEM JUSTIFIC	ATION SHEET (R-2 Exhib	oit)	DATE Febru	ary 2002
budo 03 -	BET ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603601F Conventi	onal Weapon	s Technology	
(U)	C. Program Change Summary (\$ in Thousands) Continued				
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>
	b. Small Business Innovative Research	-534			
	c. Omnibus of Other Above Threshold Reprogram	501			
	e Rescissions	-208			
(U)	Adjustments to Budget Years Since FY 2002 PBR	200		14,174	
(U)	Current Budget Submit/FY 2003 PBR	21,398	39,729	38,001	TBD
		Page 2 of 9 Pages		Exhibit R-2	(PE 0603601E)

	RDT&	E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	iry 2002
вира 03 -	GET ACTIVITY - Advanced Tech	nology Development			PE NUMBE	r and title 1F Conv	entional	Weapon	s Techno	ology	PROJECT 670A
	COST (\$ ii	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
670A	Ordnance Technolo	ogy	21,398	12,399	18,158	15,967	14,111	14,380	14,650	Continuing	0
Note the d	: In FY 2001, Project lifferent technology dev	670A and Project 670B were co velopment and demonstration p	ombined into rograms.	a single pro	oject. In FY	2002, Proje	ct 670B was	separated fr	om Project (570A for cla	rity in describing
(U)	A. Mission Descript This project develops develops conventional for conventional ordr	ion s, demonstrates, and integrates of al ordnance including warheads nance supporting an Air Expedi	ordnance tec , fuzes, expl tionary Forc	hnologies fo osives, carri e.	r enhancing age and relea	the effective ase, and mur	eness of air- nition integra	launched con ation technol	ventional w ogies. This	eapons. The project impr	e project oves capability
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$4,040	2001 (\$ in Thousands) 040 Developed and demonstrated advanced conventional armament warhead technologies, including heavy metal liners, dense metal cases, and less sensitive explosives. These warhead technologies improved target penetration capabilities, enhanced kill probability against fragmentation sensitive targets, reduced sorties to improve pilot survivability, and increased aircraft longevity. Ground tested a chemical and biological defeat warhead to characterize effectiveness against production and storage capabilities. Continued developing and evaluating concepts for neutralizing a broad spectrum of chemical and biological agents. Fabricated the tri-mode warhead and associated weapon electronics, designed									
(U)	\$4,980	Developed and demonstrated advanced air-delivered munition fuze technologies. These fuze technologies improved munitions effectiveness, and allowed smaller warheads and munition airframes, thereby increasing strike aircraft load-outs and improving sortie effectiveness. Conducted initial field test of multiple-event, hard-target fuze component design. Developed component design of an integrated fuze, improved target detection device, and directional warhead package.									
(U) (U)	\$2,489 \$2,495	Developed innovative air-delivered munition carriage and release equipment, miniature weapon release concepts, and airframe size reduction concepts. The innovative concepts provided the capability to safely carry, launch, and provide communication between the aerospace vehicle and the multiple miniature weapons, thereby increasing weapon load-outs and improving sortie effectiveness for current and future strike aircraft while reducing munition airlift requirements. Continued Unmanned Combat Air Vehicle miniature munition integration and planning support for the flight test demonstration. Completed ground and flight test of a small munition dispenser. Developed and demonstrated advanced conventional armament seeker technologies. These advanced seeker technologies were applied to the development of miniature munitions. The advanced seeker had the capability to autonomously detect, acquire, and guide to targets of interest									
Р	Project 670A	<u>^</u>		Pag	e 3 of 9 Page	es		- /	E>	- hibit R-2A	 (PE 0603601F)

		DATE							
		February 2002							
BUDO		PE NUMBER AND TITLE	PROJECT						
03 -	- Advanced Tech	nology Development	0603601F Conventional Weapons Te	chnology 670A					
(U)	A. Mission Descript	ion Continued							
(U)	FY 2001 (\$ in Thouse	ands) Continued in adverse weather and battlefield conditions, thus incr increased weapons load-out and improving sortie effec munition that will be effective against high value fixed terminal seeker for miniature munitions compatible wi	easing the probability of kill and minimizing collatera tiveness. Developed preliminary design of a terminal targets. Fabricated and captive flight tested a low-co th Unmanned Combat Air Vehicle.	l damage while providing , laser radar seeker for a miniature st, tactical sized laser radar					
(U)	\$2,410	 \$2,410 Developed and demonstrated advanced conventional armament navigation and control technologies that provided increased armament navigation accuracy, improved standoff range, enhanced weapon control and operation in electronic jamming environments. Initiated interface design between target detection device, fuze, directional warhead, and weapon terminal guidance seeker. Completed design and fabrication of an integrated laser rader terminal scalar and Global Provided Increased Interface 							
(U)	\$4,984	Integrated advanced conventional guidance technologic information, higher probability of target detection, and enhanced the effectiveness of miniature munitions again mission effectiveness, and reduced collateral damage. guidance seeker against ground fixed and mobile targe munition with integrated laser radar seeker and GPS/IN Total	es that provided improved adverse weather performan an operationally acceptable target false alarm rate. T inst both mobile and hardened fixed ground targets to Completed flight readiness review and final subsyster ts. Conducted free flight tests and analyzed flight test NS guidance to validate design and determine target fa	ce, faster processing of target hese advanced technologies reduce sortie rates, improved n integration of an autonomous data of a powered miniature lse alarm rate.					
(U)	\$21,398 EX 2002 (\$: T								
(U)	FY 2002 (\$ in Thous	ands)							
(U) (U)	\$4,290 \$4,980	sensitive explosives. The goals of these efforts are to c kill mechanisms against softer surface targets. Fabrica associated with development, production, and storage c of extremely hard targets by combining new warhead c Develop and demonstrate advanced air-delivered muni effectiveness, allowing smaller warheads and munition Sled test the multiple-event, hard target fuze in an ordrr integrated fuze, an improved target detection device, an Circuit technologies that will give burst accuracy of 0.5	lestroy hardened targets by more effectively penetrating te and test an innovative warhead capable of defeating of chemical and biological weapons. Design a weapon case technology, insensitive explosive, and multiple-ev- tion fuze technologies and mass focusing warhead tech a airframes, thereby improving sortie effectiveness by nance package. Continue cooperative program with the nd a directional warhead package. Design a fuze using 5 meter for weapons that have closure rates up to 2,50	ng protective surfaces and enhance g a broad range of soft targets n capable of high-speed penetration yent fuze. hnology to improve munition increasing strike aircraft load-outs. e United Kingdom to design an g Microwave Monolithic Integrated 0 meters/sec.					
Р	Project 670A	Page	4 of 9 Pages	Exhibit R-2A (PE 0603601F)					
			434						
	R	DT&E BUDGET ITEM JUSTIFICAT	ION SHEET (R-2A Exhibit)	DATE Februa	ary 2002				
---------------------	-----------------------------------	--	---	--	---				
BUD(03 ·	GET ACTIVITY - Advanced	Technology Development	PE NUMBER AND TITLE 0603601F Conventional Weap	ons Technology	PROJECT 670A				
(U)	A. Mission De	escription Continued							
(U) (U)	<u>FY 2002 (\$ in</u> \$3,123	Thousands) Continued Develop and demonstrate conventional muniti air-delivered munition carriage and release eq to safely carry, launch, and communicate amo increase weapon load-outs and improve sortie Integrate subsystems by combining ordnance a precision-guided weapon with a Circular Error Total	on subsystem and platform integration technologies. uipment, miniature weapon release concepts, and red ng the aerospace vehicle and multiple miniature wea effectiveness for current and future strike aircraft wh and guidance subsystem technology into an effective r Probable of 1.4 meter.	These technologies include luced airframe size providin pons. These integration tec nile reducing munition airlif payload size. Design a low	e innovative g the capability hnologies will t requirements. -cost,				
(U) (U)	\$12,399								
(U) (U)	\$6,812 \$6,715 \$4,631	Develop and demonstrate advanced convention insensitive explosives. The goals of these effor- enhance kill mechanisms against softer surface destruction production and storage facilities we high-speed penetration of extremely hard targe Begin a program to mature design of advanced Develop and demonstrate advanced air-deliver allowing smaller warheads and munition airfra- fuzing capability that will transmit function da program with the United Kingdom to design a Continue design of a fuze using Microwave M that have closure rates up to 2,500 meters per attributes that can be used to defeat hard and co be used to overpower protective tunnel doors, Develop and demonstrate conventional muniti innovative air-delivered munition carriage and capability to safely carry, launch, and commu- technologies will increase weapon load-outs a	nal armament warhead technologies, including heavy orts are to destroy hardened targets by more effective e targets. Begin designing a unitary warhead penetra ith minimum collateral damage. Continue design an ets by integrating a new warhead case technology, in d reactive materials such as nano-scale aluminum. red munitions fuze and mass focusing warhead techn ames, thereby improving sortie effectiveness and incr at from penetrating weapons through various hard ta n integrated fuze, an improved target detection devic Ionolithic Integrated Circuit technologies that will gi second. Begin design trades for a precision-guided r leeply buried targets. Simultaneous delivery of multi destroying tunnel contents with intruding blast press on subsystem and platform integration technologies. I release equipment, miniature weapon release concep- nicate among the aerospace vehicle and multiple min nd improve sortie effectiveness for current and future	y metal liners, dense metal c ly penetrating protective sur- tor capable of damaging we d begin fabrication of a wea sensitive explosive, and mu ologies to improve munition reasing strike aircraft load-or arget mediums. Continue co rea, and a directional warhead ve burst accuracy of 0.5 me nunitions with precise, time iple, precise, time-of-arrival ures. These integration technoloop pts, and reduced airframe si iature weapons. These integ-	ases, and rfaces and apons of mass apon capable of ltiple-event fuze. n effectiveness, outs. Develop a operative d package. ter for weapons -of-arrival munitions will ogies include ze providing the gration ing munition				
F	Project 670A		Page 5 of 9 Pages	Exhibit R-2A	(PE 0603601F)				
			435						

	RDT&E BUDGET ITEM JUSTIFICA	DATE February 2	2002	
BUD0 03 -	et ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603601F Conventional Weapons Te	chnology	PROJECT 670A
(U) (U)	A. Mission Description Continued FY 2003 (\$ in Thousands) Continued airlift requirements. Initiate design of a low	v-cost, precision-guided weapon with a Circular Error Probable o	f 1.4 meters and lethal	
(U)	effectiveness against 85% of the MK-83 and \$18,158 Total	d BLU-109 targets.		
(U)	<u>B. Project Change Summary</u> Not Applicable			
(U) (U) (U) (U)	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602602F, Conventional Munitions. This project has been coordinated through the Reliance process to h	harmonize efforts and eliminate duplication.		
(U)	D. Acquisition Strategy Not Applicable.			
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.			
P	roject 670A	Page 6 of 9 Pages	Exhibit R-2A (PE	0603601F)
		436 UNCLASSIFIED		

	RDT&E	E BUDGET ITEM JU	STIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDO 03 -	BUDGET ACTIVITY PE NUMBER AND TITLE PR 03 - Advanced Technology Development 0603601F Conventional Weapons Technology 67								PROJECT 670B		
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
670B	Guidance Technolc	ду	0	27,330	19,843	9,050	8,748	8,932	9,115	Continuing	0
Note the d	: In FY 2001, Project of ifferent technology dev	670A and Project 670B were co velopment and demonstration p	ombined into rograms.	a single pro	oject. In FY	2002, Projec	ct 670B was	separated fro	om Project (570A for cla	rity in describing
(U)	J) <u>A. Mission Description</u> This project develops, demonstrates, and integrates affordable, autonomous, and adverse weather advanced guidance technologies for conventional armament delivered from manned and unmanned aerospace vehicles. This project includes development of conventional weapon guidance including: terminal seekers; midcourse navigation sensors for standoff delivery weapons; and target detection and identification processing algorithms for reducing target location error to improve target kill probability.										
(U) (U) (U)	<u>FY 2001 (\$ in Thousa</u> \$0 \$0	ands) This work was performed in I Total	Project 670A	۸.							
(U) (U)	<u>FY 2002 (\$ in Thousa</u> \$2,251	ands) Develop and demonstrate adv technologies will autonomous technologies will increase the sortie effectiveness. Demons targets.	anced conve sly detect, ac probability trate laser ra	entional arm equire, and g of kill and n dar terminal	ament seeker uide to targe ninimize coll seeker for a	t technologio ts of interest ateral dama miniature n	es for minia t in adverse ge while pro- nunition that	ture munition weather and b widing increa will be effect	s' application pattlefield c used weapon tive against	ons. These s onditions. <i>A</i> ns load-out a t high-value	eeker Ilso, the seeker nd improved fixed and mobile
(U)	 W) \$2,133 Develop and demonstrate advanced conventional armament navigation and control technologies to provide increased armament navigation accuracy, improved standoff range, enhanced weapon control, and operation in electronic jamming environments. Develop interface design between target detection device, fuze, directional warhead, and weapon terminal guidance seeker. Complete design and fabrication of an integrated laser radar terminal seeker and Global Positioning System/(nertial Navigation System (GPS/INS) navigation and control system 										
(U)	\$3,146	Integrate advanced conventio weather performance, faster p alarm rate, and enhance the eff	nal guidance rocessing of ffectiveness	e technologie f target infor of miniature	es including mation, high munitions a	seekers, proo er probabilit gainst both 1	cessors, con ty of target of mobile and l	trols, and algorithm detection, and algorithm detection, and hardened fixed	orithms. Pr operationall d ground ta	ovide impro y acceptable rgets. Comp	ved adverse target false plete flight
Р	roject 670B			Pag	e 7 of 9 Page	s			Ex	hibit R-2A	(PE 0603601F)

	RDT&	DATE February 20	002		
виро 03 -	GET ACTIVITY • Advanced Tec	hnology Development	PE NUMBER AND TITLE 0603601F Conventional Weapons Te	chnology	PROJECT 670B
(U)	A. Mission Descrip	tion Continued			
(U)	FY 2002 (\$ in Thous	ands) Continued readiness review and final subsystem integrat flight tests and analyze flight test data of a po demonstrate design and determine target false	tion of an autonomous guidance seeker against ground fixed an owered miniature munition with integrated laser radar seeker an e alarm rate.	d mobile targets. Conduc d GPS/INS guidance to	t free
(U)	\$19,800	Enhance the current Low Cost Autonomous A flight and ground testing. Additional LOCAA integrated technologies perform as expected a aircraft. Other ATD tasks will include contin Attack System datalink to improve cooperative evaluating electronic safe and arm fuzing.	Attack System (LOCAAS) Advanced Technology Demonstration AS ATD tasks include flight testing of a LOCAAS with a live wand preparing the LOCAAS flight test vehicle for carriage and muing automatic target recognition algorithm development; design we attack and communicate bomb damage assessment to the context of the conte	on (ATD) program by add varhead to demonstrate the release from a tactical fight gning the Low Cost Auto nmand and control netwo	ding more nat the hter nomous ork; and
(U)	\$27,330	Total			
(U)	FY 2003 (\$ in Thous	sands)			
(U)	\$2,784	Develop and demonstrate advanced convention technologies will autonomously detect, acqui technologies will increase the probability of the sortic effectiveness. Begin developing a low	onal armament seeker technologies for miniature munitions app re, and guide to targets of interest in adverse weather and battle cill and minimize collateral damage while providing increased cost laser radar seeker using DARPA-developed fixed detect	lications. These seeker field conditions. Also, th veapons load-out and important technology	1e seeker proved
(U)	\$1,932	Develop and demonstrate advanced convention improve stand off range, enhance weapons condetection device, fuze, directional warhead, a electromechanical system technology to provi than \$6,000 per unit) Global Positioning System	onal armament navigation and control technologies to increase ontrol, and operation in electronic jamming environments. Dev nd weapon terminal guidance seeker. Develop a munition navi ide an accurate (less than one meter), miniature (less than 25 cu tem/Inertial Measurement Unit navigation system.	armament navigation accuration interface between a figation system using micribic inches), and affordab	uracy, target :o- ble (less
(U)	\$4,127	Integrate advanced conventional guidance tec weather performance, faster processing of tar alarm rate, and enhance the effectiveness of r and fabrication of a low-cost seeker, guidance re-locatable targets.	chnologies including seekers, processors, controls, and algorithm get information, higher probability of target detection, an opera niniature munitions against both mobile and hardened fixed gro e hardware, and autonomous target recognition software for a s	ns. Provide improved ad tionally acceptable target ound targets. Begin devel mall bomb to attack mobi	iverse t false lopment ile and
(U)	\$11,000	Enhance the current LOCAAS ATD program	by adding more flight and ground testing. Additional LOCAA	S ATD tasks include flig	sht testing
Р	roject 670B		Page 8 of 9 Pages	Exhibit R-2A (PE 0	603601F)

	RDT&E BUDGET ITEM JUSTIFICATI	DATE February 2002	
BUD(03 -	BET ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603601F Conventional Weapons Te	PROJECT chnology 670B
03 - (U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	Advanced Technology Development A. Mission Description Continued FY 2003 (\$ in Thousands) Continued of a LOCAAS with a live warhead to demonst the LOCAAS flight test vehicle from a tactical development, designing the LOCAAS datalink control network, and evaluating electronic safe \$19,843 Total B. Project Change Summary Not Applicable. C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602602F, Conventional Munitions This project has been coordinated through the Reliance process to har. D. Acquisition Strategy Not Applicable. E. Schedule Profile Not Applicable.	of the integrated technologies perform as expected. Also a fighter aircraft. Other ATD tasks will include continuing aut to improve cooperative attack and communicate bomb damage and arm fuzing.	o, the ATD will include separating omatic target recognition algorithm ge assessment to the command and
Ρ	roject 670B	Page 9 of 9 Pages 439	Exhibit R-2A (PE 0603601F)

THIS PAGE INTENTIONALLY LEFT BLANK

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								Februa	iry 2002
BUDGE 03 - A	r ACTIVITY			PE NUMBE	r and title 5F Adva	nced We	apons Te	echnolog	јУ	
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	41,407	66,905	28,271	32,420	33,998	37,305	38,140	Continuing	TBD
3150	Advanced Optics Technology	14,869	22,178	260	898	1,121	3,277	3,350	Continuing	TBD
3151	High Power Solid State Laser Technology	3,582	5,410	8,830	14,566	15,437	16,133	16,439	Continuing	TBD
3152	High Power Microwave Technology	8,022	11,114	12,952	11,614	11,765	11,954	12,117	Continuing	TBD
3647	High Energy Laser Technology	14,934	28,203	6,229	5,342	5,675	5,941	6,234	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: In FY 2003, space unique tasks in Projects 3150 and 3647 will be transferred to PE 0603500F in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) <u>A. Mission Description</u>

This PE 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 2002, Congress added \$7 million for Geo Light Imaging National Testbed (GLINT), \$1.7 million for sodium wavelength laser, \$1.7 million for Manufacturing Analysis for the Advanced Tactical Laser, \$6.4 million for the Aerospace Relay Mirror System, \$8.5 million for the Field Laser Demonstration Upgrades, and \$1.5 million for Laser Spark Countermeasures.

(U) <u>B. Budget Activity Justification</u>

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.

Page 1 of 15 Pages	Exhibit R-2 (PE 0603605F)
441	

				DATE	
	RDT&E BUDGET ITEM JUSTIFIC	Febru	ary 2002		
BUD	SET ACTIVITY	PE NUMBER AND TITLE			
03 ·	· Advanced Technology Development	0603605F Advance	d Weapons To	echnology	
(U)	C. Program Change Summary (\$ in Thousands)				
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	Total Cost
(U)	Previous President's Budget	42,973	43,758	37,744	
(U)	Appropriated Value	43,371	67,558		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions		-653		
	b. Small Business Innovative Research	-1,018			
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram	-548			
	e. Rescissions	-398			
(U)	Adjustments to Budget Years Since FY 2002 PBR			-9,473	
(U)	Current Budget Submit/FY 2003 PBR	41,407	66,905	28,271	TBD
(U)	Significant Program Changes:				
	In FY 2002, Congress added \$7 million for Geo Light Imaging N	National Testbed (GLINT), \$1.7 million for	r sodium waveleng	gth laser, \$1.7 million for	or Manufacturing
	Analysis for the Advanced Tactical Laser, \$6.4 million for the A	Aerospace Relay Mirror System, \$8.5 milli	ion for the Field La	user Demonstration Upg	grades, and \$1.5
	million for Laser Spark Countermeasures.				
	Decrease in FY 2003 is due to space unique efforts being moved	to PE 0603500F.			

Page 2 of 15 Pages

Exhibit R-2 (PE 0603605F)

	RDT&I	E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	iry 2002
вирс 03 -	BUDGET ACTIVITY PE NUMBER AND TITLE 03 - Advanced Technology Development 0603605F Advanced Weapons Technology								PROJECT 3150		
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3150	Advanced Optics T	echnology	14,869	22,178	260	898	1,121	3,277	3,350	Continuing	
Note space	: In FY 2003, space unique activities.	nique tasks in Project 3150 will	be transferr	ed to PE 060	03500F in co	njunction w	ith the Space	e Commissio	on recomme	ndation to co	nsolidate all
(U)	U) <u>A. Mission Description</u> This project develops advanced optical technologies for locating, identifying, and analyzing distant and dim objects such as geosynchronous orbit satellites. This work supports high energy laser applications in target verification, accurate and sustainable laser beam placement on target, and near-real-time damage assessment. Several advanced technologies including adaptive optics and specialized optical processing are being developed. The goal is high quality optical image reconstruction, concentrating on removing turbulent atmosphere-induced distortions. In addition to the primary defense applications, many of the technologies have significant astronomy research applications.										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$197	ands) Developed advanced optical t control technologies applicab components. These technologies Advances were made in the a number of optical component	technologies le to space-b gies support bility to proj	for correction based system applications ect a wide ra- weight and c	on of laser be as in a contro s such as targ ange of laser	eams for pro lled laborate get acquisition wavelength ith the goal	jection and o pry environn on, tracking a s and power of making la	optical imag nent with lab and pointing s in a single	ing application poratory scal , target design optical systematical	ons. Demor ed breadboar gnation, and em and in mi	nstrated beam rds and remote sensing. nimizing the
(U)	\$184	Investigated advanced conception beam relay. Continued to put with the required speed, resol	ots to deploy rsue compon ution, and p	and use larg ent develops ower handling	ge space-base ment of adva ng capability	ed mirrors fo inced optical for space re	or application materials and a materials and a materials and a materials and a material sector and a material sector and a material sector a	ns such as in nd devices the pplications.	naging, laser hat can be sc	r beam projection beam project	ction, and laser 1 larger sizes
(U)	\$7,727	Continued to develop technol for the Geo Light Imaging Na software for passive identific:	ogies for act ational Testb ation of sate	ive imaging ed (GLINT) llites in supp	of geosynch at White Sa ort of GLIN	nonous spac nds Missile T experimer	e objects. C Range, NM. nts.	continued de Developed	velopment a /tested opera	nd integratio	n of hardware ures and
(U)	 Solution of the planet of the p										
Р	roject 3150			Page	3 of 15 Pag	es			E>	hibit R-2A	(PE 0603605F)

	RD	DATE Feb	ruary 2002		
вирс 03 -	GET ACTIVITY	Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapo	ons Technology	PROJECT 3150
(U)	A. Mission De	scription Continued			
(U)	FY 2001 (\$ in 7	Thousands) Continued			
(U)	\$14,869	Total			
(U)	FY 2002 (\$ in '	Thousands)			
(U)	\$489	Develop and laboratory test advanced a tracking, and pointing applications. Exp steering in scaled laboratory environme optical systems to enable their use in sp	daptive optical technologies to support beam stabilization plore liquid crystal technology for advanced adaptive op nt. Technology development work is aimed at reducing ace platforms.	on, imaging applications, and otics to demonstrate non-mea weight, power consumption	d target acquisition, chanical beam n, and complexity of
(U)	\$6,338	Develop technologies for an aerospace r telescopes in space and autonomous alig Develop point ahead beacon technology	relay mirror. Develop and optimize techniques for dual gnment of two telescopes. Design an optical payload to <i>y</i> .	line of sight pointing from t perform beam characterizat	wo separate ion and clean up.
(U)	\$6,933	Develop technologies for active imaging Light Imaging National Testbed (GLIN identification of satellites in support of t	g of geosynchronous space objects. Continued develop T) at White Sands Missile Range, NM. Develop/test op GLINT experiments.	ment and integration of hard perating procedures and soft	ware for the Geo ware for passive
(U)	\$8,418	Continue to explore the utility of an ope deep space metric and space object iden technology development with the object for a variety of battlefield surveillance r	erational Field Laser Demonstrator laser radar integrated atification missions, microsatellite tracking and ballistic tive of providing compact, remote sensing systems for in mission applications.	l with the Advanced Electro missile defense discriminati ntegration onboard unmanne	-Optical System for on. Continue ed aerial platforms
(U)	\$22,178	Total			
(U)	FY 2003 (\$ in '	Thousands)			
(U)	\$260	This project previously included space under the project previously included space under the provided space of	unique efforts which have been transferred to PE 060350 s represent the civilian salaries for the work effort transf	00F, Multi-disciplinary Space erred and they will be transf	ce Advanced erred at a later date.
(U)	\$260	Total			
(U)	<u>B. Project Cha</u> Not Applicable	ange Summary 5.			
Р	roject 3150		Page 4 of 15 Pages	Exhibit R-	2A (PE 0603605F)
			444		

	RDT&E BUDGET ITEM JUSTIFICATION S	DATE February 2002	
BUD(03 ·	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Techn	PROJECT Ology 3150
(U) (U) (U) (U) (U) (U) (U) (U) (U)	 C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0603444F, Maui Space Surveillance Systems. PE 0602102F, Materials. PE 0602605F, Directed Energy Technology. PE 0603883C, Ballistic Missile Defense Boost Phase Segment. PE 0602500F, Multi-Disciplinary Space Technology. PE 0603500F, Multi-Disciplinary Advanced Development Space Technology This project has been coordinated through the Reliance process to harmonize 	efforts and eliminate duplication.	
(U)	D. Acquisition Strategy Not Applicable.		
(U) (U)	E. Schedule Profile Not Applicable.		
F	Project 3150 Page	5 of 15 Pages	Exhibit R-2A (PE 0603605F)
		445	

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)									DATE February 2002	
вирс 03 -	GET ACTIVITY Advanced Tech	nology Development			PE NUMBE	r and title 5F Adva	TITLE Advanced Weapons Technology			łУ	PROJECT 3151
	COST (\$ ii	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3151	High Power Solid S	State Laser Technology	3,582	5,410	8,830	14,566	15,437	16,133	16,439	Continuing	
(U)	A. Mission Description This project continues to yield revolutionary breakthroughs in compact, robust, and affordable laser system technology for a wide range of military applications requiring small compact laser sources. This is a long-term technology development project with both near-term and long-term payoff. Near-term goals include developing compact, reliable infrared sources that can be used for a range of applications including night vision systems, landing zone markers, remote sensing, and covert communication systems. Longer-term goals focus on producing compact, significantly higher power sources that could be applied to military weapons-type applications including aircraft self-protection. This project leads the development of, and builds upon, a wide range of commercial advancements. Commercially available solid state lasers are widely used due to their low-cost, small size and weight, high reliability, and high efficiency in converting electricity to laser energy. This project preserves these attractive features while continually scaling output to higher powers and efficiencies and to military application-specific wavelengths. This project is divided into two technology areas. The first area investigates methods to develop low-cost, scalable, high power solid state lasers. This effort builds upon a strong industrial technology base. Secondly, wavelength specific solid state lasers for military applications such as infrared countermeasures are developed.										
(U) (U)	FY 2001 (\$ in Thouse \$1,852	ands) Developed low-cost, scalable, energy applications such as un airborne lasers. Demonstrated	, high power nmanned aer d a fiber lase	solid state l rial vehicle c r module, w	aser architec lesignators/ii ith no free s	tures by inte magers and interpretent	egrating fibe next generat elements. at	r lasers with ion weapons	diode-laser applications of watts of	pump source s such as spa power.	es for directed ce-based and
(U)	\$1,037	Developed and demonstrated surface-to-air missile threats. average power, for countering	laser source Continued og current gen	and beam co development aration threa	ontrol techno of a reliable ats to aircraf	ologies need e four micros t platforms.	ed to counte n wavelengt	r current and h solid state	l next genera laser, with a	ation air-to-a goal of achi	ir and eving five watts
(U)	\$693	Developed and demonstrated missile threats. Demonstrated jet aircraft and large aircraft s	novel target l novel device elf-protection	coupling tec ce structures	chnologies n and incoher	eeded to cou ent beam co	inter current mbining tec	and next ge hniques for i	neration air- mproving be	to-air and su eam quality,	rface-to-air required for fast
(U)	\$3,582	Total	L								
Р	roject 3151			Page	6 of 15 Pag	es			Ex	hibit R-2A	(PE 0603605F)

	RDT&I	DATE February 2002								
вирс 03 -	GET ACTIVITY Advanced Tech	nology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Techr	PROJECT Nology 3151						
(U)	A. Mission Descript	ion Continued								
(U)	<u>FY 2002 (\$ in Thous</u>	ands) Develop low cost cooleble, high newer colid state los	n analyticatures by integrating filter lagers with diada 1	occurrent courses for directed						
(0)	energy applications such as unmanned aerial vehicle designators/imagers and next generation weapons applications such as space-based and airborne lasers. Begin work to demonstrate high electrical efficiency (approaching 30%) and beam combining at high power to enable applications requiring high power lasers. Demonstrate coherent beam combining of two 100 watt amplifiers showcasing the building block technology of future directed energy, weapons-class electric lasers. Demonstrate wavelength-versatile integrated laser/nonlinear optics at five watt power levels. Continue development of an all-fiber solution, with no free space optical elements, at power levels approaching 100 watts.									
(U)	\$2,835	Develop and demonstrate laser source needed to coun source (two and four microns) with sufficient brightne developed in FY 2001, for countering current generati	ter current air-to-air and surface-to-air missile threats. ss, based on novel device structures and incoherent be on threats to aircraft platforms.	Demonstrate a multi-wavelength am combining techniques						
(U)	 \$863 Develop and demonstrate high-energy laser and beam control, technologies for airborne tactical applications, including air-to-air and surface-to-air scenarios. Technologies being addressed include lasers for long-range detection of targets in clutter and advanced beam control to control platform vibration, atmospheric jitter, and aero-optic effects. Initiate laser effect testing using a multi-kilowatt laser to determine required energy levels for tactical applications that address next generation threats. 									
(U)	\$5,410	Total								
(U) (U)	<u>FY 2003 (\$ in Thous</u> \$4,951	ands) Demonstrate low-cost, scalable, high power solid state energy applications such as unmanned aerial vehicle of airborne lasers. Demonstrate high electrical efficiency high power lasers. Demonstrate coherent beam comb at moderate powers. Demonstrate wavelength-versati all-fiber solution, with no free space optical element, a	e laser architectures by integrating fiber lasers with dio lesignators/imagers and next generation weapons appli y (goal greater than 30%) and coherent beam combinin ining to achieve one kilowatt and integration technolog le integrated laser/non-linear optics at 10 watt power le at power levels greater than 100 watts.	de-laser pump sources for directed cations such as space-based and g to enable applications requiring gies for multiple fiber laser modules evels. Continue development of an						
(U)	\$3,351	Develop and demonstrate laser source technologies ne reliable and compact multispectral (bands I. II. and IV	eded to counter current air-to-air and surface-to-air mi	ssile threats. Demonstrate a reats to aircraft platforms.						
(U)	\$528	Develop and demonstrate high-energy laser technolog Technologies being addressed include lasers for long- control to control platform vibration, atmospheric jitte	r, and aero-optic effects. Complete laser effects testing	ir and surface-to-air scenarios. act lasers, and advanced beam g using a multi-kilowatt laser to						
Р	roject 3151	Page	7 of 15 Pages	Exhibit R-2A (PE 0603605F)						

	RDT&E BUDGET ITEM JUSTIFICATION S	DATE February 2002					
BUD0 03 -	BET ACTIVITY • Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Techr	PROJECT Ology 3151				
(U) (U) (U) (U)	A. Mission Description Continued FY 2003 (\$ in Thousands) Continued determine required energy levels for tactical applicatio \$8,830 Total B. Project Change Summary Not Applicable.	ns that address next generation threats.					
 (U) (U) (U) (U) (U) (U) (U) (U) 	C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602102F, Materials. PE 0603270F, Electronic Combat Technology. PE 0602605F, Directed Energy Technology. This project has been coordinated through the Reliance process to harmonize of D. Acquisition Strategy	efforts and eliminate duplication.					
(U) (U)	Not Applicable. <u>E. Schedule Profile</u> Not Applicable.						
Р	Project 3151 Page	8 of 15 Pages	Exhibit R-2A (PE 0603605F)				
	448						

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)									DATE February 2002	
BUDO 03 -	ET ACTIVITY Advanced Tec	hnology Development			PE NUMBER AND TITLE 0603605F Advanced Weapons Techn				echnolog	PROJECT ology 3152	
	COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3152	High Power Micro	wave Technology	8,022	11,114	12,952	11,614	11,765	11,954	12,117	Continuing	
(U)	A. Mission Description This project develops high power microwave (HPM) generation and transmission technologies that support a wide range of Air Force missions such as the potential denial, degradation, damage, or destruction of an adversary's electronic infrastructure and military capability. These targeted capabilities include local computer and 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 no collateral structural or human damage. Millimeter wave force protection technologies are also developed. It also develops a susceptibility/vulnerability/lethality data base to identify potential vulnerabilities of U.S. systems to HPM threats and to provide a basis for future offensive and defensive weapons system decisions. Representative U.S. and foreign assets are tested to understand real system susceptibilities. Both wideband (wide frequency range) and narrowband (very small frequency range) technologies are being developed.										
(U) (U)	<u>FY 2001 (\$ in Thou</u> \$3,416	sands) Developed and demonstrated Demonstrated and quantified	HPM techno the effective	blogies to response of a rep	nder inopera petitively pul	tive electron sed system	ic componen against elect	nts of an adv ronic targets	ersary's inte of interest.	grated air de Conducted	fense system. a full power
(U)	\$2,997	Developed and demonstration to Developed and demonstrated experiments with brassboard validate their accuracy	HPM techno devices to do fectiveness	blogies to resemble a constrate cons	nder inopera command and red HPM sul	tive command control wat control wat	nd and contr rfare effectiv Applied cor	nt. ol componer zeness. Inve nputer codes	nts of an adv stigated setu s to predict c	ersary. Con up of ground coupling to ta	ducted field -based, field argets and
(U)	\$1,609	validate their accuracy. Developed, demonstrated, and evaluated active denial technology for several non-lethal mission applications including future peacekeeping assignments. Began human testing demonstrations of vehicle-mounted non-lethal directed energy weapons technology. Continued investigations for man-portable applications. Analyzed critical technologies for airborne active denial applications, including beam control,									
(U)	\$8,022	Total		6							
Р	roject 3152			Page	9 of 15 Page	es			Ex	hibit R-2A	(PE 0603605F)
					449						

	RDT8	E BUDGET ITEM JUSTIFICATION	SHEET (R-2A Exhibit)	DATE February 2002
BUDG 03 -	BET ACTIVITY Advanced Tec	chnology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Techr	PROJECT 10logy 3152
(U)	A. Mission Descrip	otion Continued		
(U) (U)	<u>FY 2002 (\$ in Thou</u> \$4,370	<u>usands</u>) Develop and demonstrate narrowband high power mi Demonstrate pulsed power and narrowband HPM sou HPM technology for multi-gigawatt application deve to air missiles. Develop and demonstrate wideband H	crowave (HPM) technologies to damage or destroy an a irce capability applicable to munitions and airborne con lopment. Evaluate narrowband technologies to address IPM technologies to disrupt, degrade, damage, or destru-	adversary's electronic systems. cepts. Select repetitively pulsed s aircraft protection against surface by an adversary's command and
(U)	\$2,178	control and infrastructure. Develop integrated compa effectiveness in HPM munitions and airborne electron Conduct effects experimentation on targets to refine s building probability of effect database using experim modeling and simulation codes to more accurately pr models for engagement models. Continue to investig system against electronic targets of interest applicable	act source design(s) based on effects data and technolog nic attack missions. source parameters, expand target set, and support suscep ental data from several programs. Transition selected to edict wideband HPM coupling in realistic scenarios. Co gate and develop models to quantify the effectiveness of e to munitions or airborne platforms.	y advances for improved otibility predictions. Begin echnologies. Continue to refine omplete probability of effect a narrowband repetitively pulsed
(U)	\$2,066	Develop and evaluate active denial technologies for r active denial Investigate test cell development of mi	non-lethal weapons applications. Continue analysis of c	ritical technologies for airborne
(U)	\$2,500	Develop the means to integrate HPM devices onto un concepts. Investigate the feasibility of using ultra-wi assessment. Perform lethality assessments of HPM o	amanned aerial platforms. Perform integration, thermal deband HPM to geolocate and identify targets of interest n targets of interest to gauge the military utility and effe	control, and target studies for such st, and perform battle damage ectiveness of the integrated HPM
(U)	\$11,114	Total		
(U) (U)	<u>FY 2003 (\$ in Thou</u> \$4,970	Isands) Develop and demonstrate narrowband HPM technolo Demonstrate pulsed power and narrowband HPM sou pulsed gigawatt-class HPM experiment. Conduct wid wideband HPM for munitions and airborne electronic air-delivered HPM munitions.	gies to disrupt, degrade, damage, or destroy an adversative capability applicable to munitions and airborne condeband field experiments with integrated compact device attack. Conduct initial ground-based, field experiment	ry's electronic systems. cepts. Demonstrate a repetitively ces to demonstrate effectiveness of ts demonstrating effectiveness of
(U)	\$2,270	Continue effects experimentation to expand database targets and validate their accuracy. Continue to invest	and support susceptibility predictions. Apply compute stigate and develop models to quantify the effectiveness	r codes to predict coupling to of a narrowband repetitively
Р	roject 3152	Page	10 of 15 Pages	Exhibit R-2A (PE 0603605F)

	RDT&	DATE February 2002								
BUD 03	get activity - Advanced Tecl	nnology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Tech	PROJECT nology 3152						
(U)	A. Mission Descript	ion Continued								
(U)	FY 2003 (\$ in Thous	ands) Continued								
(U)	 pulsed system against electronic targets of interest applicable to munitions or airborne platforms. \$2,012 Develop and evaluate active denial technologies for non-lethal weapons applications. Demonstrate next generation vehicle-mounted non-lethal weapons technology. Begin development of millimeter wave source for airborne applications. 									
(U)	 \$3,700 Weapons technology. Begin development of millimeter wave source for airborne applications. \$3,700 Develop the means to integrate high power microwave (HPM) devices onto unmanned aerial platforms. Continue integration and target studies for such concepts while beginning investigation of thermal control issues. Define the vehicle integration environment for a HPM device. Investigate the feasibility of using ultra-wideband HPM to geolocate and identify targets of interest, and perform battle damage assessment. Continue to perform lethality assessments of HPM on targets of interest to gauge the military utility and effectiveness of the integrated HPM concept 									
(U)	\$12,952	Total								
(U)	B. Project Change S Not Applicable.	Summary								
(U) (U) (U) (U) (U)	C. Other Program I Related Activities: PE 0602202F, Huma PE 0602605F, Direct This project has been	Funding Summary (\$ in Thousands) n Systems Technology. ed Energy Technology. coordinated through the Reliance process to harmonize	efforts and eliminate duplication.							
(U)	D. Acquisition Strat Not Applicable.	egy								
(U) (U)	E. Schedule Profile Not Applicable.									
F	Project 3152	Page	11 of 15 Pages	Exhibit R-2A (PE 0603605F)						

	RDT&E	E BUDGET ITEM JU	ISTIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDG 03 -	ET ACTIVITY Advanced Tech	nology Development			PE NUMBE	r and title 5F Adva	nced We	apons To	echnolog	PROJEC ology 3647	
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3647	High Energy Laser	Technology	14,934	28,203	6,229	5,342	5,675	5,941	6,234	Continuing	
Note: space	In FY 2003, space un unique activities.	nique tasks in Project 3647 wil	l be transfer	red to PE 06	03500F in co	onjunction w	ith the Spac	e Commissi	on recomme	endation to co	onsolidate all
(U)	5) A. Mission Description This project provides for the development, demonstration, and detailed assessment of technology needed for high energy laser weapons that are not space unique. 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) (U)	<u>FY 2001 (\$ in Thousa</u> \$664 \$5,849	Performed vulnerability assessments on potential high energy laser targets to provide critical design data for laser systems to defeat these targets. Reviewed/developed the system-level deny/disrupt/damage/destroy criteria for counterspace high energy laser systems, based on new data from satellite vulnerability assessments. Transitioned an improved tool for the analysis of high-resolution optical images to the National Air Intelligence Center.									
(U)	\$5,449	 Performed atmospheric compensation/beam control experiments from Starfire Optical Range 3.5-meter telescope for ground-based platforms to support applications including antisatellite weapons, satellite health and diagnostics, and high-resolution satellite imaging. Continued characterization of return signals from laser illuminated satellites to design system for active (laser-illuminated) tracking of unaugmented low earth orbit satellites. Analyzed data from previous satellite imaging and tracking experiments for design of 24-hour laser beam control system. Designed a target-loop atmospheric compensation system for laser projection to satellites on weapons-class beam director (3.5-meter telescope). Modeled and analyzed long-path atmospheric effects for design of advanced adaptive optics for low-elevation compensation of lasers and imaging. Developed and evaluated enhanced beam control/compensation techniques for atmospheric attenuation and distortion on laser beam propagation from airborne platforms for applications such as theater missile defense. Continued computer simulation of additional advanced concepts for active tracking and atmospheric compensation using adaptive optics under propagation conditions representative of typical 									
P	roject 3647			Page	12 of 15 Pag	ges			E>	hibit R-2A	(PE 0603605F)

	RDT8	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)							
BUDO 03 -	GET ACTIVITY - Advanced Teo	chnology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Tech	PROJECT nology 3647					
(U)	A. Mission Descri	ption Continued							
(U)	FY 2001 (\$ in Tho	<u>isands) Continued</u> airborne laser engagement scenarios. Conducted a turbulence phase screens. Performed passive track Developed and integrated hardware for future stati advanced concepts under propagation conditions s	advanced active tracking and adaptive optics laboratory ex king demonstrations, anisoplanatism studies, and common ic and dynamic active tracking and atmospheric compensa caled to represent those expected in airborne laser engage	periments using representative -path/common-mode studies. tion demonstrations using ment scenarios.					
(U)	\$2,972	Continued to investigate the LaserSpark missile co- effectiveness of the multiple internal laser effects (focal plane array seeker mockups using properly for plane array seekers. Continued design planning a effectiveness on in-flight seekers.	ountermeasure technology. Developed and demonstrated (MILE) associated with plasma/sparks. Continued laboratormatted laboratory lasers. Developed flyout simulations nd coordination for a limited field demonstration of aimpo	he infrared countermeasures cory testing of MILE on advanced of MILE on conical scan and focal point control and countermeasure					
(U)	\$14,934	Total							
(U)	<u>FY 2002 (\$ in Thou</u>	<u>isands)</u> Derforme endrandeiliter opportunite op meterstiel bie	h an anna la can tana ta ta anna ida aniti a l da cian data fan la						
(0)	\$ 4 98	Provide data from sure-safe analysis to Air Force S data fusion of optical and radar measurements of s	space Command, for setting standards for laser illumination pace objects.	on of space objects. Improve the					
(U)	\$8,413	Perform atmospheric compensation/beam control of antisatellite weapons, relay mirror systems, satellite propagation to satellite targets and use the detailed validate propagation models. Design and begin in optics with higher bandwidth signal processing and control demonstration. Design Rayleigh beacon p weapons-class beam director (3.5-meter telescope)	experiments from the Starfire Optical Range 3.5-meter tel te health and diagnostics, and high-resolution satellite ima l measurements of energy and beam profile on target to ch tegration of laser beam control system using active trackin d enhanced data capture capabilities. Integrate scoring las oint-ahead atmospheric compensation system for laser pro	escope for applications including ging. Perform compensated laser aracterize anisoplanatic effects and ng and target return loop adaptive ser and sensors for integrated beam ojection to satellites on					
(U)	\$12,372	Develop and evaluate beam control/compensation airborne platforms for applications such as theater weapon system to missile targets. Develop and der negative optical turbulence effects on an uncompe expected in airborne laser engagements. Begin wa	techniques for atmospheric attenuation and distortion on a missile defense. These efforts will enhance high energy a monstrate in the laboratory advanced tracking and adaptiv nsated high energy laser beam under propagation condition ave-optics simulation of two wavefront sensors to enhance	aser beam propagation from aser delivery from an airborne laser e optics methods to mitigate the ons scaled to represent those e the ability to correct for					
Р	Project 3647	Pa	age 13 of 15 Pages	Exhibit R-2A (PE 0603605F)					
			453						

	RDT	&E BUDGET ITEM JUSTIFICA	DATE February 2002							
BUDG 03 -	GET ACTIVITY	echnology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Tee	PROJECT						
(U)	A. Mission Desc	ription Continued								
(U)	FY 2002 (\$ in Thousands) Continued atmospheric disturbances. Update wave-optics computer simulations based on field test results to more effectively evaluate and improve subsequent advanced concents									
(U)	\$2,067	Develop and demonstrate the technology fo other potential weapon applications. Evalua and laboratory nozzle test stand. Explore io advanced chemical oxygen iodine test seque	r scalable, high energy laser devices with improved efficienc ate and optimize multiple high pressure ejector nozzles perfor indine injection and iodine generation methods and select the r ence utilizing a laboratory test stand.	y, for insertion in airborne lasers and mance using modeling and simulation nost promising for insertion into						
(U)	 \$1,683 Develop and analyze technology that supports manufacturing of the Advanced Tactical Laser (ATL). Collect vibration data on appropriate aircraft to better understand the dynamic disturbances that would be encountered on an ATL. Evaluate other effects, such as thermal blooming and aero-optical aberrations, that have the potential to severely limit an ATL's performance. Evaluate designs and manufacturing capability for compact inertial reference units, including upgrades to the Stabilized Inertial Measurement System stable platform, to reject base motion 									
(U)	\$1,486	Continue to investigate the LaserSpark miss countermeasure effectiveness of the multipl components and subsystems to establish err array seeker mockups. Assess IRCM effect laboratory hardware experiments to validate	sile Infrared Countermeasure (IRCM) technology and develop e internal laser effects (MILE) associated with plasma/sparks or budgets and performance specifications. Continue testing iveness on flyout simulations of MILE on conical scan and f e flyout modeling and anchor computer simulations.	o/demonstrate the infrared . Conduct critical experiments on of MILE on advanced focal plane focal plane array seekers. Conduct						
(U)	\$1,684	Fabricate brassboard sodium-wavelength la Design and begin radiometry experiments to combining sodium and Rayleigh laser beaco	ser to be used as mesospheric beacon for adaptive optics syst o characterize sodium beacon performance. Begin design of ons for atmospheric compensation of large telescopes at visib	ems on large-aperture telescopes. nybrid beacon adaptive optics system le and near-infrared wavelengths.						
(U)	\$28,203	Total		C						
(U)	FY 2003 (\$ in Th	ousands)								
(U)	\$1,192	This project previously included space uniq Development Technology. These funds rep	ue efforts which have been transferred to PE 0603500F, Mul- resent the civilian salaries for the work effort transferred and	i-disciplinary Space Advanced they will be transferred at a later date.						
(U)	\$371	Perform vulnerability assessments on poten	tial high energy laser targets to provide critical design data for	r laser systems to defeat these targets.						
(U)	\$3,564	Develop and evaluate beam control/compen airborne platforms for applications such as t	sation techniques for atmospheric attenuation and distortion the techniques for atmospheric attenuation and distortion the technique attenues. These efforts will enhance high energy the technique attenues at the technique attenues a	on laser beam propagation from gy laser delivery from an airborne laser						
Р	roject 3647		Page 14 of 15 Pages	Exhibit R-2A (PE 0603605F)						

	RD	DT&E BUDGET ITEM JUSTIFICA	ATION SHEET (R-2A Exhibit)	DATE February 2002
BUDO	GET ACTIVITY		PE NUMBER AND TITLE	PROJECT
03 -	Advanced	Technology Development	0603605F Advanced Weapons Techr	ology 3647
(U)	A. Mission De	escription Continued		
(U)	FY 2003 (\$ in	<u>Thousands) Continued</u> weapon system to missile targets. Demons ratio (peak intensity on target) in stressing ability to correct for atmospheric disturban target. Initiate demonstration and evaluation demonstrated beam control performance.	strate advanced tracking methods and adaptive optics compensatio atmospheric turbulence. Evaluate the performance of various wave aces. Assess candidate advanced track algorithms to increase stabi on of the compensated beacon illumination technique. Anchor wa	n techniques that double the Strehl vefront sensors to maximize the lity of the high power beam on ve optics propagation code to the
(U) (U)	\$1,102 \$6,229	Develop and demonstrate the technology for other potential weapon applications. Conti simulation and laboratory nozzle test stand into an advanced chemical oxygen iodine t Total	for scalable, high energy laser devices with improved efficiency for inue to evaluate and optimize multiple high pressure ejector nozzle l evaluations. Begin integration of most promising iodine injection test sequence utilizing a laboratory test stand.	r insertion in airborne lasers and es performance using modeling and n and iodine generation methods
(U)	B. Project Ch Not Applicable	ange Summary e.		
(U) (U) (U) (U) (U) (U) (U) (U)	C. Other Prog Related Activit PE 0602605F, PE 0603883C, PE 0602500F, PE 0603500F, This project ha The technology	ties: Directed Energy Technology. Ballistic Missile Defense Boost Phase Segment. Multi-Disciplinary Space Technology. Multi-Disciplinary Advanced Development Space 's been coordinated through the Reliance process to y efforts in this PE that are supporting future enhance	Technology. harmonize efforts and eliminate duplication. cements to airborne lasers have been coordinated with the Airborn	e Laser program office.
(U)	D. Acquisition Not Applicable	<u>Strategy</u>		
(U) (U)	E. Schedule Pr Not Applicable	<u>rofile</u>		
P	roject 3647		Page 15 of 15 Pages	Exhibit R-2A (PE 0603605F)
			155	

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 2002	
BUDGET ACTIVITY 03 - Advanced Technology Development			PE NUMBE 060372	r and title 3F Envir	onmenta	I Engine	ering Teo	chnology	PROJECT 2103
COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2103 Environmental Quality Technology	968	0	0	0	0	0	0	0	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0
 te: In FY 2000, the Air Force terminated this program. However, Congress added \$1.5 million to restore this program in FY 2000 and another \$4.0 million for ivironmental Systems Management Analysis and Reporting Network (E-SMART). In FY 2001, Congress added another \$1.0 million for Joint environmental clean-up. A. Mission Description This program develops and demonstrates advanced technologies to address Air Force-unique environmental compliance, site remediation, and pollution prevention problems. FY 2001 (\$ in Thousands) \$968 Develop technologies for Joint Environmental Clean-up. \$968 Total FY 2002 (\$ in Thousands) \$0 No Activity \$0 Total FY 2003 (\$ in Thousands) \$0 No Activity 									
(U) <u>B. Budget Activity Justification</u> This program is in Budget Activity 3, Advanced Te environmental problems. Project 2103	chnology De	velopment, s Pag	since it devel e 1 of 3 Page	ops and den	nonstrates ad	lvanced tech	nologies to a	address Air I Exhibit R-2 (Force-unique (PE 0603723F)

BUDGET ACTIVITY PE NUMBER AND TITLE PEQUECT 03 - Advanced Technology Development 0603723F Environmental Engineering Technology 2103 (I) C. Program Chance Summary (\$ in Thousands) FY 2001 FY 2002 FY 2003 Total C (U) Adjustments to Appropriated Value 991 0 0 0 (U) Adjustments to Appropriated Value 1,000 0 0 a. Congressional/General Reductions -23 -23 -23 b. Small Business Innovative Research -23 -23 0 0 (U) Current Budget Submit/FY 2003 PBR 968 0 0 TE (U) Current Budget Submit/FY 2003 PBR 968 0 0 TE (U) Current Budget Submit/FY 2003 PBR 968 0 0 TE (U) Significant Program Changes: In FY 2000, the Air Force terminated this program. However, Congress added \$1.5 million to restore this program in FY 2000 and another \$4.0 million for Environmental Systems Management Analysis and Reporting Network (E-SMART). In FY 2001, Congress added another \$1.0 million for joint environmental Clean-up. (U) D.Other Program Funding Summary (\$ in Thousands) In FO 2002 PA PE 60		RDT&E BUDGET ITEM JUSTIFICATION	SHEET (R	-2 Exhi	ibit)	DATE Februar	y 2002
O3 - Advanced Technology Development 0603723F Environmental Engineering Technology 2103 (1) C. Program Change Summary (\$ in Thousands) FY 2001 FY 2002 Total C (1) Previous President's Budget 991 0 0 1 (1) Appropriated Value 1,000 0 0 1 (1) Appropriated Value 1,000 0 0 1 (2) Appropriated Value 1,000 0 0 1 (3) Adjustments to Appropriated Value -23 -23 -23 -23 0 (1) Adjustments to Budget Years Since FY 2002 PBR 0 0 0 1 (2) Significant Program Changes: -9 0 0 1 (1) Significant Program Changes: -9 0 0 1 (2) Significant Program Changes: 0 0 1 1 (3) Significant Program Funding Summary (\$ in Thousands) 1 1 1 1 (4) Significant Program Funding Summary (\$ in Thousands) 1 1 1 1 (1) Significant Program Funding Summary (\$ in Thousands) 1 1 1 1 (2)	BUDO	GET ACTIVITY	PE NUMBER A	ND TITLE			PROJECT
U C. Program Change Summary (S in Thousands) FY 2001 FY 2002 FY 2003 Total C (V) Previous President's Budget 991 0 0 0 (U) Appropriated Value 1,000 0 0 0 (U) Appropriated Value 1,000 0 0 0 (U) Adjustments to Appropriated Value -23 - - 0 (a. Congressional/Concental Reductions -23 - - 0<	03 -	Advanced Technology Development	0603723F	Environ	mental Engineerin	g Technology	2103
$\begin{tabular}{ c c c c } \hline FY 2001 & FY 2002 & FY 2003 & Total C \\ \hline FY 2004 & FY $	(U)	C. Program Change Summary (\$ in Thousands)					
(U)Previous President's Budget99100(U)Appropriated Value1,0000(U)Adjustments to Appropriated Value1,0000a. Congressional/General Reductionsa. Congressional/General Reductionsa. Congressional/General Reductionsb. Small Business Innovative Research-23-23c. Onnibus or Other Above Threshold Reprogram-23-24d. Below Threshold Reprogram-90(U)Adjustments to Budget Years Since FY 2002 PBR00(U)Current Budget Submit/FY 2003 PBR96800TE(U)Significant Program Changes: In FY 2000, the Air Force terminated this program. However, Congress added \$1.5 million to restore this program in FY 2000 and another \$4.0 million for Environmental Systems Management Analysis and Reporting Network (E-SMART). In FY 2001, Congress added another \$1.0 million for joint environmental clean-up.(U)D. Other Program Funding Summary (\$ in Thousands)				FY 2001	<u>FY 2002</u>	FY 2003	Total Cost
 (1) Appropriated Value (1) Adjustments to Appropriated Value a. Congressional/General Reductions b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram e. Rescissions e. Rescissions 9 (1) Adjustments to Budget Years Since FY 2002 PBR 0 (1) Current Budget Submit/FY 2003 PBR 968 0 0 TE (1) Significant Program Changes; In FY 2000, the Air Force terminated this program. However, Congress added \$1.5 million to restore this program in FY 2000 and another \$4.0 million for Environmental Systems Management Analysis and Reporting Network (E-SMART). In FY 2001, Congress added another \$1.0 million for joint environmental clean-up. (1) Duther Program Funding Summary (\$ in Thousands) (1) Related Activities: (1) PE 0602102F, Materials. (1) PE 0602202F, Human Effectiveness Applied Research. (2) PE 0602202F, Human Effectiveness Applied Research. (3) PE 0602311F, Acrospace Propulsion. (4) PE 0603231F, Acrospace Structures. (5) PE 0603231F, Crew Systems and Personnel Protection Technology. (6) PE 0603216F, Acrospace Structures. (7) PE 0603216F, Crew Systems and Personnel Protection Technology. (7) PE 060321F, Acrospace Structures. (7) PE 060321F, Acrospace Structures. (7) PE 060321F, Crew Systems and Personnel Protection Technology. (7) PE 060321F, Crew Systems and Personnel Protection Technology. (7) PE 0603716D, Strategic Environmental Research and Development Program. (7) PE 0604708F, Other Operational Equipment. 	(U)	Previous President's Budget		991	0	0	
 (U) Adjustments to Appropriated Value a. Congressional/General Reductions b. Small Business Innovative Research c. Omnibus or Other Above Threshold Reprogram c. Below Threshold Reprogram c. Rescissions -9 (U) Adjustments to Budget Years Since FY 2002 PBR O O Current Budget Submit/FY 2003 PBR 968 O O TF Significant Program Changes: In FY 2000, the Air Force terminated this program. However, Congress added \$1.5 million to restore this program in FY 2000 and another \$4.0 million for Environmental Systems Management Analysis and Reporting Network (E-SMART). In FY 2001, Congress added another \$1.0 million for joint environmental clean-up. (U) D. Other Program Funding Summary (S in Thousands) (U) PE 0602102F, Human Effectiveness Applied Research. (U) PE 0602102F, Human Effectiveness Applied Research. (U) PE 0603211F, Aerospace Structures. (U) PE 0603211F, Aerospace Structures. (U) PE 0603211F, Crew Systems and Personnel Protection Technology. (U) PE 0603211F, Crew Systems and Personnel Protection Program. (U) PE 0603231F, Crew Systems and Personnel Protection Program. (U) PE 060331F, Crew Systems. (U) PE 060331F, Cre	(U)	Appropriated Value		1,000	0		
a. Congressional/General Reductions b. Small Business Innovative Research c. Ormibus of Other Above Threshold Reprogram d. Below Threshold Reprogram e. Rescission of Herither State Strice FY 2002 PBR of (U) Current Budget Submit/FY 2003 PBR 968 0 0 (U) Significant Program Changes: In FY 2000, the Air Force terminated this program. However, Congress added \$1.5 million to restore this program in FY 2000 and another \$4.0 million for Environmental Systems Management Analysis and Reporting Network (E-SMART). In FY 2001, Congress added another \$1.0 million for joint environmental clean-up. (U) D. Other Program Funding Summary (S in Thousands) (U) Related Activities: (U) PE 0602202F, Materials. (U) PE 0602202F, Materials. (U) PE 0602202F, Acrospace Propulsion. (U) PE 0602202F, Advanced Materials for Weapon Systems (U) PE 0603231F, Crew Systems and Personnel Protection Technology. (U) PE 0603231F, Crew Systems. (U) PE 060331F, Crew Systems. (U) PE 060371F, Crew Systems. ((U)	Adjustments to Appropriated Value					
b. Small Business Innovative Research -23 c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram e. Rescissions -9 (U) Adjustments to Budget Years Since FY 2002 PBR 0 (U) Adjustments to Budget Years Since FY 2002 PBR 968 0 (U) Significant Program Changes: In FY 2000, the Air Force terminated this program. However, Congress added \$1.5 million to restore this program in FY 2000 and another \$4.0 million for Environmental Systems Management Analysis and Reporting Network (E-SMART). In FY 2001, Congress added another \$1.0 million for joint environmental clean-up. (U) D. Other Program Funding Summary (\$ in Thousands) (U) PE 0602102F, Materials. (U) PE 0602102F, Human Effectiveness Applied Research. (U) PE 0603211F, Advanced Materials for Weapon Systems (U) PE 0603211F, Aerospace Structures. (U) PE 0603211F, Aerospace Structures. (U) PE 0603311F, Crew Systems and Personnel Protection Technology. (U) PE 0603311F, Crew Systems and Personnel Protection Technology. (U) PE 0603311F, Crew Systems and Personnel Protection Technology. (U) PE 0604706F, Life Support Systems. (U) PE 0604706F, Life Support Systems. (U) PE 0604706F, Other Operational Equipment. (Project 2103 Page 2 of 3 Pages Exhibit R-2 (PE 0603723F)		a. Congressional/General Reductions					
c. Omnibus or Other Above Threshold Reprogram d. Below Threshold Reprogram e. Rescissions -9 (U) Adjustments to Budget Years Since FY 2002 PBR 0 (U) Current Budget Submit/FY 2003 PBR 968 0 (U) Significant Program Changes: In FY 2000, the Air Force terminated this program. However, Congress added \$1.5 million to restore this program in FY 2000 and another \$4.0 million for Environmental Systems Management Analysis and Reporting Network (E-SMART). In FY 2001, Congress added another \$1.0 million for joint environmental clean-up. (U) D. Other Program Funding Summary (S in Thousands) (U) Related Activities: (U) PE 0602102F, Materials. (U) PE 0602202F, Human Effectiveness Applied Research. (U) PE 0602202F, Human Effectiveness Applied Research. (U) PE 0602311F, Advanced Materials for Weapon Systems (U) PE 0603311F, Advanced Materials for Weapon Systems (U) PE 0603311F, Areospace Structures. (U) PE 0603311F, Areospace Structures. (U) PE 0603311F, Crew Systems and Personnel Protection Technology. (U) PE 0603311F, Crew Systems and Personnel Protection Program. (U) PE 0603716D, Strategic Environmental Security Technology Certification Program. (U) PE 0603716D, Strategic Environmental Security Technology Certification Program. (U) PE 0603716D, Strategic Environmental Research and Development Program. (U) PE 0603716D, Strategic Environmental Research and Development Program. (U) PE 0603716D, Strategic Environmental Research and Development Program. (U) PE 0603716D, Strategic Environmental Recervity Technology Certification Program. (U) PE 0603716D, Strategic Environmental Recervity Technology Certification Program. (U) PE 0604706F, Life Support Systems. (U) PE 0604706F, Other Operational Equipment.		b. Small Business Innovative Research		-23			
 d. Below Threshold Reprogram e. Rescissions -9 Adjustments to Budget Years Since FY 2002 PBR 0 Current Budget Submit/FY 2003 PBR 968 0 0 TE (U) Significant Program Changes: In FY 2000, the Air Force terminated this program. However, Congress added \$1.5 million to restore this program in FY 2000 and another \$4.0 million for Environmental Systems Management Analysis and Reporting Network (E-SMART). In FY 2001, Congress added another \$1.0 million for joint environmental clean-up. (U) D. Other Program Funding Summary (\$ in Thousands) (U) PE 0602102F, Materials. (U) PE 0602203F, Aterials. (U) PE 0602203F, Aterials. (U) PE 06032112F, Advanced Materials for Weapon Systems (U) PE 0603211F, Aerospace Structures. (U) PE 0603211F, Aerospace Structures. (U) PE 0603211F, Crew Systems and Personnel Protection Technology. (U) PE 0603211F, Crew Systems and Personnel Protection Technology. (U) PE 0603211D, Crategic Environmental Research and Development Program. (U) PE 0604706F, Life Support Systems. (U) PE 0604706F, Life Support Systems. (U) PE 0604708F, Other Operational Equipment. 		c. Omnibus or Other Above Threshold Reprogram					
 e. Rescissions -9 (U) Adjustments to Budget Years Since FY 2002 PBR 0 O Current Budget Submit/FY 2003 PBR 968 0 O TF (U) Significant Program Changes: In FY 2000, the Air Force terminated this program. However, Congress added \$1.5 million to restore this program in FY 2000 and another \$4.0 million for Environmental Systems Management Analysis and Reporting Network (E-SMART). In FY 2001, Congress added another \$1.0 million for joint environmental clean-up. (U) D.Other Program Funding Summary (\$ in Thousands) (U) Related Activities: (U) PE 0602102F, Materials. (U) PE 0602202F, Human Effectiveness Applied Research. (U) PE 0602203F, Aerospace Propulsion. (U) PE 0603211F, Crew Systems and Personnel Protection Technology. (U) PE 0603211F, Crew Systems and Personnel Protection Technology. (U) PE 0603231F, Crew Systems. (U) PE 0603231F, Crew Systems. (U) PE 0604706F, Life Support Systems. (U) PE 0604706F, Life Support Systems. (U) PE 0604708F, Other Operational Equipment. (U) PE 0604708F, Other Operational Equipment. (U) PE 0604708F, Other Operational Equipment. 		d. Below Threshold Reprogram					
(U) Adjustments to Budget Years Since FY 2002 PBR 0 (U) Current Budget Submit/FY 2003 PBR 968 0 0 TF (U) Significant Program Changes: In FY 2000, the Air Force terminated this program. However, Congress added \$1.5 million to restore this program in FY 2000 and another \$4.0 million for Environmental Systems Management Analysis and Reporting Network (E-SMART). In FY 2001, Congress added another \$1.0 million for joint environmental clean-up. (U) D. Other Program Funding Summary (\$ in Thousands) . (U) P. Other Program Funding Summary (\$ in Thousands) . (U) P. Other Program Funding Summary (\$ in Thousands) . (U) PE 0602102F, Materials. . (U) PE 0602203F, Aerospace Propulsion. . (PE 0603211F, Aerospace Propulsion. . . (PE 0603311c, Crew Systems and Personnel Protection Technology. . . (U) PE 0603716D, Strategic Environmental Research and Development Program. . (PE 0604706F, Life Support Systems. . . (U) PE 0604706F, Life Support Systems. . (U) PE 0604706F, Other Operational Equipment. .		e. Rescissions		-9			
(U) Current Budget Submit/FY 2003 PBR 968 0 0 TE (U) Significant Program Changes: In FY 2000, the Air Force terminated this program. However, Congress added \$1.5 million to restore this program in FY 2000 and another \$4.0 million for Environmental Systems Management Analysis and Reporting Network (E-SMART). In FY 2001, Congress added another \$1.0 million for joint environmental clean-up. V (U) D. Other Program Funding Summary (\$ in Thousands) V V Related Activities: V V (U) PE 0602102F, Materials. V PE 0602202F, Human Effectiveness Applied Research. V V V (U) PE 0602202F, Human Effectiveness Applied Research. V <	(U)	Adjustments to Budget Years Since FY 2002 PBR			0		
 (U) Significant Program Changes: In FY 2000, the Air Force terminated this program. However, Congress added \$1.5 million to restore this program in FY 2000 and another \$4.0 million for Environmental Systems Management Analysis and Reporting Network (E-SMART). In FY 2001, Congress added another \$1.0 million for joint environmental clean-up. (U) D. Other Program Funding Summary (\$ in Thousands) (U) Related Activities: (U) PE 0602102F, Materials. (U) PE 0602203F, Aerospace Propulsion. (U) PE 0603211F, Advanced Materials for Weapon Systems (U) PE 0603211F, Aerospace Structures. (U) PE 0603211F, Crew Systems and Personnel Protection Technology. (U) PE 0603723F, Crew Systems and Personnel Protection Technology. (U) PE 0604706F, Life Support Systems. (U) PE 0604708F, Other Operational Equipment. (U) PE 0604708F, Other Operational Equipment. 	(U)	Current Budget Submit/FY 2003 PBR		968	0	0	TBD
 (U) D. Other Program Funding Summary (\$ in Thousands) (U) Related Activities: (U) PE 0602102F, Materials. (U) PE 0602202F, Human Effectiveness Applied Research. (U) PE 0602203F, Aerospace Propulsion. (U) PE 0603112F, Advanced Materials for Weapon Systems (U) PE 0603211F, Aerospace Structures. (U) PE 0603231F, Crew Systems and Personnel Protection Technology. (U) PE 0603716D, Strategic Environmental Research and Development Program. (U) PE 0603851D, Environmental Security Technology Certification Program (U) PE 0604706F, Life Support Systems. (U) PE 0604708F, Other Operational Equipment. 		In FY 2000, the Air Force terminated this program. However, Congress adde Environmental Systems Management Analysis and Reporting Network (E-SM clean-up.	ed \$1.5 million (MART). In FY	to restore thi 2001, Cong	is program in FY 2000 and ress added another \$1.0 mi	l another \$4.0 million illion for joint environ	for nmental
 (U) Related Activities: (U) PE 0602102F, Materials. (U) PE 0602202F, Human Effectiveness Applied Research. (U) PE 0602203F, Aerospace Propulsion. (U) PE 0603112F, Advanced Materials for Weapon Systems (U) PE 0603211F, Aerospace Structures. (U) PE 0603231F, Crew Systems and Personnel Protection Technology. (U) PE 0603716D, Strategic Environmental Research and Development Program. (U) PE 0603851D, Environmental Security Technology Certification Program (U) PE 0604706F, Life Support Systems. (U) PE 0604708F, Other Operational Equipment. 	(U)	D. Other Program Funding Summary (\$ in Thousands)					
 (U) PE 0602102F, Materials. (U) PE 0602202F, Human Effectiveness Applied Research. (U) PE 0602203F, Aerospace Propulsion. (U) PE 0603112F, Advanced Materials for Weapon Systems (U) PE 0603211F, Aerospace Structures. (U) PE 0603231F, Crew Systems and Personnel Protection Technology. (U) PE 0603716D, Strategic Environmental Research and Development Program. (U) PE 0603851D, Environmental Security Technology Certification Program (U) PE 0604706F, Life Support Systems. (U) PE 0604708F, Other Operational Equipment. 	(U)	Related Activities:					
 (U) PE 0602202F, Human Effectiveness Applied Research. (U) PE 0602203F, Aerospace Propulsion. (U) PE 0603112F, Advanced Materials for Weapon Systems (U) PE 0603211F, Aerospace Structures. (U) PE 0603231F, Crew Systems and Personnel Protection Technology. (U) PE 0603716D, Strategic Environmental Research and Development Program. (U) PE 0603851D, Environmental Security Technology Certification Program (U) PE 0604706F, Life Support Systems. (U) PE 0604708F, Other Operational Equipment. 	(U)	PE 0602102F, Materials.					
 (U) PE 0602203F, Aerospace Propulsion. (U) PE 0603112F, Advanced Materials for Weapon Systems (U) PE 0603211F, Aerospace Structures. (U) PE 0603231F, Crew Systems and Personnel Protection Technology. (U) PE 0603716D, Strategic Environmental Research and Development Program. (U) PE 0603851D, Environmental Security Technology Certification Program (U) PE 0604706F, Life Support Systems. (U) PE 0604708F, Other Operational Equipment. 	(U)	PE 0602202F, Human Effectiveness Applied Research.					
 (U) PE 0603112F, Advanced Materials for Weapon Systems (U) PE 0603211F, Aerospace Structures. (U) PE 0603231F, Crew Systems and Personnel Protection Technology. (U) PE 0603716D, Strategic Environmental Research and Development Program. (U) PE 0603851D, Environmental Security Technology Certification Program (U) PE 0604706F, Life Support Systems. (U) PE 0604708F, Other Operational Equipment. 	(U)	PE 0602203F, Aerospace Propulsion.					
 (U) PE 0603211F, Aerospace Structures. (U) PE 0603231F, Crew Systems and Personnel Protection Technology. (U) PE 0603716D, Strategic Environmental Research and Development Program. (U) PE 0603851D, Environmental Security Technology Certification Program (U) PE 0604706F, Life Support Systems. (U) PE 0604708F, Other Operational Equipment. Project 2103 Page 2 of 3 Pages Exhibit R-2 (PE 0603723F)	(U)	PE 0603112F, Advanced Materials for Weapon Systems					
 (U) PE 0603231F, Crew Systems and Personnel Protection Technology. (U) PE 0603716D, Strategic Environmental Research and Development Program. (U) PE 0603851D, Environmental Security Technology Certification Program (U) PE 0604706F, Life Support Systems. (U) PE 0604708F, Other Operational Equipment. Project 2103 Page 2 of 3 Pages Exhibit R-2 (PE 0603723F)	(U)	PE 0603211F, Aerospace Structures.					
 PE 0603716D, Strategic Environmental Research and Development Program. PE 0603851D, Environmental Security Technology Certification Program PE 0604706F, Life Support Systems. PE 0604708F, Other Operational Equipment. Project 2103 Page 2 of 3 Pages Exhibit R-2 (PE 0603723F)	(U)	PE 0603231F, Crew Systems and Personnel Protection Technology.					
 PE 0603851D, Environmental Security Technology Certification Program PE 0604706F, Life Support Systems. PE 0604708F, Other Operational Equipment. Project 2103 Page 2 of 3 Pages Exhibit R-2 (PE 0603723F)	(U) (U)	PE 0603/16D, Strategic Environmental Research and Development Program.					
(U) PE 0604708F, Other Operational Equipment. (U) Project 2103 Page 2 of 3 Pages Exhibit R-2 (PE 0603723F)	(U) (D)	PE 0603851D, Environmental Security Technology Certification Program					
Project 2103 Page 2 of 3 Pages Exhibit R-2 (PE 0603723F)	(U)	PE 0604709F, Life Support Systems.					
Project 2103 Page 2 of 3 Pages Exhibit R-2 (PE 0603723F)	(U)	PE 0004/08F, Other Operational Equipment.					
	Р	roject 2103 Page	e 2 of 3 Pages			Exhibit R-2 (P	E 0603723F)

	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 2	2002	
BUD 03	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603723F Environmental Engineering	g Technology	PROJECT 2103
(U) (U)	D. Other Program Funding Summary (\$ in Thousands) This project has been coordinated through the Reliance process to harmonize	efforts and eliminate duplication.		
(U)	E. Acquisition Strategy Not Applicable.			
(U) (U)	<u>F. Schedule Profile</u> Not Applicable.			
F	Project 2103 Page	e 3 of 3 Pages	Exhibit R-2 (PE 0)603723F)
	UNC	459 LASSIFIED		

THIS PAGE INTENTIONALLY LEFT BLANK

	RDT&E BUDGET ITEM J	DATE	DATE February 2002							
BUDGET ACTIVITY PE NUMBER AND TITLE 03 - Advanced Technology Development 0603726F Aerospace Info Tech Sys Integration										
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	6,964	0	0	0	0	0	0	Continuing	TBD
2810	Advanced Image/Information/Optical Memory Technology Applications	4,053	0	0	0	0	0	0	Continuing	TBD
4850	Collaborative C2	2,911	0	0	0	0	0	0	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: In FY 2002, efforts in Projects 2810 and 4850 move into PE 0603789F Projects 4072 and 4925, respectively, as part of the Air Force Science and Technology (S&T) PE realignment.

(U) <u>A. Mission Description</u>

This program develops and demonstrates Aerospace Command, Control, Communications, and Intelligence (C3I) technologies for collaborative command and control (C2) with emphasis on a coalition/joint environment. This includes the areas of information and knowledge production, data fusion, data links, wideband storage, and processing, retrieval, and exploitation of C3I databases. A family of exploitation tools to extract information from multi-sensor data sources will be developed. An enabling fusion architecture to work with existing and future fusion engines will also be designed and built to correlate and integrate this information to produce a consistent knowledge of the battle space over a distributed and collaborative C2 environment. Information storage and retrieval technologies for secure global database distribution, of sufficient capacity and speed to meet Air Force requirements, will be developed. A collaborative C2 operations foundation between dispersed command centers will be developed to demonstrate split force operations and enable decision making in a distributed aerospace information framework.

(U) <u>B. Budget Activity Justification</u>

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 a military utility and address warfighter needs.

Page 1 of 6 Pages

Exhibit R-2 (PE 0603726F)

	RDT&E BUDGET ITEM JUSTIFIC	DATE Febru	ary 2002		
BUD 03	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603726F Aerospac	ce Info Tech S	Sys Integration	
(U)	C. Program Change Summary (\$ in Thousands)				
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	Total Cos
(U)	Previous President's Budget	7,361	0	0	
(U)	Appropriated Value	7,429	0		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	175			
	b. Small Business Innovative Research	-175			
	c. Omnibus or Other Above Threshold Reprogram	222			
	a. Below Threshold Reprogram	-222			
an	e. Rescissions Adjustments to Budget Vears Since EV 2002 PBP	-08			
(0)	Current Budget Submit/FY 2003 PBR	6 964	0	0	TBL
	In FY 2002, efforts in this PE move to PE 0603789F, Projects 4	072 and 4925.			

Page 2 of 6 Pages

Exhibit R-2 (PE 0603726F)

	RDT&E	E BUDGET ITEM JU	STIFIC	ATION	SHEET	(R-2A E	xhibit)			DATE	Februa	ry 2002
виро 03 -	BET ACTIVITY Advanced Tech	nology Development			PE NUMBE	R AND TITLE	space Inf	o Tech S	Sys Ir	nteg	ration	PROJECT 2810
	COST (\$ ir	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2 Estin	007 nate	Cost to Complete	Total Cost
2810	Advanced Image/In Technology Applica	formation/Optical Memory tions	4,053	0	0	0	0	0		0	Continuing	TBD
(U)	 ote: In FY 2002, efforts move into PE 0603789F, Project 4072 as part of the Air Force Science and Technology (S&T) PE realignment. J. <u>A. Mission Description</u> This project develops and demonstrates techniques and algorithms to meet weapon systems requirements for processed and fused multi-source information needed for mission planning, navigation, targeting, and terrain analysis. It provides generic language translation processing techniques, state-of-the-art algorithms for Air Force exploitation of digitally processed image and spatial (i.e., latitude, longitude, and elevation) database products, automated capabilities to reference and display hypermedia (multi-media) information, and defensive information warfare technologies. This project also develops erasable optical data storage systems with high capacity and fast input/output speed for fighter aircraft (to provide fast airborne access to mission-oriented data and the digital terrain system) and electronic surveillance aircraft (for on-board sensor data recording, operational mission planning requirements, and large data storage requirements (i.e., high-volume, soft-copy, digital imagery exploitation). Algorithms will be developed to automate the selection, retrieval, and downloading of information stored on mass storage devices that are distributed across the data network. Three-dimensional (3-D) memory systems will be developed for volumetric digital data storage. This new mass storage 											
(U) (U) (U)	<u>FY 2001 (\$ in Thousa</u> \$1,030 \$1,822 \$1,201	nnds) Develop and demonstrate adv information, adaptive sensor f develop planning and assessm supporting the battlespace info Develop and demonstrate adv access, extract, process, and d situational awareness. Develo analysis tools, and situation as Develop and demonstrate adv for strategic and tactical appli write-once, read-many, and en	anced signal fusion engine nent technolo osphere. anced data h isplay multi op and demo ssessment ca anced storag cations. Co rasable mem	l exploitation e, and spatia ogies to supp nandling and -source intel onstrate even upability for ge and memo ntinue devel ories. This t	n technologi l database te port strategy event visual lligence and t visualization decision sup pory technolog opment and echnology e	es. Develop chnologies f developmen lization tech sensor datab on, natural la port operatio gies. Contin demonstratio nhances sens	and demons for transition and campa nologies. Do bases to impro- anguage pro- cons. ue to develo on of ultra-d sor exploitat	strate advance to Commor ign assessme evelop and c rove the sens cessing for in op smart mer ense storage ion for incre	eed ima of Operation ent in a lemons or exp nforma nory au , and f ased si	agery ationa a distr strate a ploitati ation e nd ass cast pa ituatio	and signal ir l Picture. Co ibuted enviro automated ca on process f xtraction, co ociative reca rallel access nal awarene	atelligence ontinue to onment apabilities to or near-real-time illaborative all technologies technologies for ss and
Р	roject 2810			Page	e 3 of 6 Page	es				Ex	hibit R-2A ((PE 0603726F)

	RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Ex	hibit) DATE February 200	2
BUD0 03 -	OGET ACTIVITY PE NUMBER AND TITLE - Advanced Technology Development 0603726F Aerosp	pace Info Tech Sys Integration 28	OJECT
(U) (U) (U) (U) (U) (U) (U)	A. Mission Description Continued FY 2001 (\$ in Thousands) Continued interactive simulation for distributed mission training. \$4,053 Total FY 2002 (\$ in Thousands) \$0 Efforts move to PE 0603789F, Project 4072. \$0 Total FY 2003 (\$ in Thousands)		
(U) (U) (U)	FY 2003 (\$ in Thousands) \$0 No Activity \$0 Total B. Project Change Summary		
(U) (U) (U) (U) (U)	Not Applicable. <u>C. Other Program Funding Summary (\$ in Thousands)</u> Related Activities: PE 0602702F, Command, Control, and Communications (C3). PE 0603789F, C3I Advanced Development. This project has been coordinated through the Reliance process to harmonize efforts and eliminate dupli	ication.	
(U) (U) (U)	D. Acquisition Strategy Not Applicable. E. Schedule Profile Not Applicable		
Р	Project 2810 Page 4 of 6 Pages	Exhibit R-2A (PE 0603	3726F)

	RDT&	E BUDGET ITEM JU	STIFIC	ATION	SHEET	(R-2A E	xhibit)		DA	Februa	ary 2002
budo 03 -	BET ACTIVITY Advanced Tec	hnology Development			PE NUMBE 060372	r and title 6F Aeros	space Inf	o Tech S	ys Inte	gration	PROJECT 4850
	COST (\$	in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4850	Collaborative C2		2,911	0	0	0	0	0		0 Continuing	TBD
Note	In FY 2002, efforts	move into PE 0603789F, Project	4925 as par	t of the Air	Force Science	e and Techn	nology (S&T) PE realign	ment.		
< - /	This project develops and demonstrates technologies for the next generation of distributed collaborative environments, which will provide cross disciplinary information to a decision maker when, where, and how it is needed. Technologies developed will permit advanced integrated information architectures for the near-real-time transfer of large volumes of information over existing and future command, control, and communications systems. The application of these new technologies will allow reconfiguration and adaptation of existing operational aerospace systems to support seamless integrated operations, and facilitate an affordable implementation of the battlespace infosphere concept. These are enabling technologies for collaborative command and control, simulation-based acquisition, and distributed mission training.										
(U)	FY 2001 (\$ in Thou	sands)									
(U)	\$1,017	Develop and demonstrate nex to simulation-based acquisition Aerospace Force.	t generation on, pre-planr	distributed of the distributed o	collaborative ibuted missi	e environmen on training,	nts. Assess and problem	and demonst solving for	rate the ap a lean and	plication of th agile Expedit	ese technologies ionary
(U)	\$934	Define and develop integrated information collection assets near-real-time among expedit and demonstrate aerospace ar and adaptation of existing ope	l aerospace i on airborne ionary aeros chitecture te erational aero	information and space pl pace forces. chnology to ospace syste	architectures atforms to b Assess the provide an a ms to suppo	 Define and e automatica application of affordable bar rt seamless i 	d develop in ally optimally of these tech attlespace int ntegrated op	tegrated info y tasked, and nologies to t fosphere ope erations.	rmation a the colle he time-cr ration. Tl	rchitectures th cted information itical target do nis will allow to	at enable on shared in omain. Develop reconfiguration
(U)	 \$960 Develop technology to increase aerospace platform information transfer capacity for exchange of time-critical threat, sensor, and command and control information between aircraft and cooperating space, airborne, and surface communication assets. Continue the development of communications technologies that support collaborative command and control. Complete a space-based air traffic communications and positioning brassboard demonstrating the capability to meet Federal Aviation Administration and International Civil Aviation Organization directed Global Air Traffic Management requirements in fighter and bomber aircraft. 										
(U)	\$2,911	Total									
Р	roject 4850			Page	e 5 of 6 Page	es				Exhibit R-2A	(PE 0603726F)
					465						

	RDT&E BUDGET ITEM JUSTIFICATION	DATE February 2002	
виро 03 -	et activity Advanced Technology Development	PE NUMBER AND TITLE 0603726F Aerospace Info Tech Sys II	PROJECT ntegration 4850
(U) (U) (U) (U) (U) (U) (U)	A. Mission Description Continued $FY 2002 (\$ in Thousands)$ $\$0$ Efforts move to PE 0603789F, Project 4925. $\$0$ TotalFY 2003 (\$ in Thousands) $\$0$ No Activity $\$0$ Total		
(U) (U) (U) (U) (U) (U)	 B. Project Change Summary Not Applicable. C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602702F, Command, Control, and Communications (C3). PE 0603789F, C3I Advanced Development. This project has been coordinated through the Reliance process to harmonized 	e efforts and eliminate duplication.	
(U) (U) (U)	D. Acquisition Strategy Not Applicable. E. Schedule Profile Not Applicable.	T	
Ρ	roject 4850 Pag	ge 6 of 6 Pages	Exhibit R-2A (PE 0603726F)

	RDT&E BUDGET ITEM J	DATE	February 2002							
BUDGE 03 - /	T ACTIVITY Advanced Technology Development			PE NUMBER AND TITLE 0603789F C3I Advanced Development						
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	18,252	33,217	34,288	36,190	32,728	32,921	33,283	Continuing	TBD
4072	Dominant Battlespace Awareness	9,411	11,128	16,093	15,765	12,244	12,478	12,716	Continuing	TBD
4216	Battlespace Information Exchange	3,889	11,640	6,984	6,564	6,602	6,729	6,856	Continuing	TBD
4872	Dynamic Aerospace C2 & Execution	4,952	7,436	9,303	11,549	11,963	11,757	11,717	Continuing	TBD
4925	Collaborative C2	0	3,013	1,908	2,312	1,919	1,957	1,994	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	Continuing	TBD

Note: In FY 2002, efforts previously accomplished in PE 0603726F, Project 4850, move into Project 4925, and efforts previously accomplished in PE 0603726F, Project 2810, move into Project 4072. These actions are part of the Air Force's Science and Technology PE realignment.

(U) <u>A. Mission Description</u>

This program develops and demonstrates Aerospace Command, Control, Communications, and Intelligence (C3I) technologies to 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 all pertinent 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 Dynamic Aerospace Command, Control, and Execution 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 Command and Control (C2) project provides the technology and demonstrations needed to establish virtual, distributed C2 centers, allowing the majority of the C2 center resources to remain in CONUS, 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 2002,

Page 1 of 17 Pages Exhibit R-2 (PE 0603789F)
467
UNCLASSIFIED

	RDT&E BUDGET ITEM JUSTIFICA	TION SHEET (R-2 Exhib	oit)	DATE Febru	ary 2002
вирс 03 -	BET ACTIVITY Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3I Adva	nced Develop	oment	
(U)	A. Mission Description Continued Congress added \$1.7 million for Adaptive Information Protection Te for Information Protection and Authentication Systems.	echnologies and \$3.0 million for Infor	mation Hiding, Ste	ganography, and Digita	al Watermarking
(U)	B. Budget Activity Justification This program is in Budget Activity 3, Advanced Technology Develor system developments that have military utility and address warfighter	opment, since it develops and demonstr er needs.	rates technologies for	or existing system upg	rades and/or new
(U)	<u>C. Program Change Summary (\$ in Thousands)</u>				
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>
(U)	Previous President's Budget	19,289	32,273	34,497	
(U)	Appropriated Value	19,468	33,542		
(0)	Adjustments to Appropriated Value		325		
	h Small Business Innovative Research	-257	-323		
	c. Omnibus or Other Above Threshold Reprogram	-251			
	d. Below Threshold Reprogram	-780			
	e. Rescissions	-179			
(U)	Adjustments to Budget Years Since FY 2002 PBR			-209	
(U)	Current Budget Submit/FY 2003 PBR	18,252	33,217	34,288	TBD
(U)	<u>Significant Program Changes:</u> Not Applicable				
		Page 2 of 17 Pages		Exhibit R-2	2 (PE 0603789 <u>F)</u>

	RDT&	E BUDGET ITEM JU	STIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	nry 2002	
BUDG 03 -	BUDGET ACTIVITYPE NUMBER AND TITLEPROJECTD3 - Advanced Technology Development0603789F C3I Advanced Development4072											
	COST (\$ ii	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost	
4072	Dominant Battlespa	ace Awareness	9,411	11,128	16,093	15,765	12,244	12,478	12,716	Continuing	TBD	
Note: (U)	 te: Prior to FY 2002, a portion of this effort was accomplished in PE 0603726F, Project 2810. <u>A. Mission Description</u> This project develops, integrates, and demonstrates advanced technologies as needed to achieve Dominant Battlespace Awareness (DBA) using information from all sources, exploiting government and commercial technologies. DBA is the information required to support dynamic planning and execution with the accuracy, fidelity, and timeliness needed to dominate in battle (reference Joint Vision 2010 and 2020). Technology development to achieve DBA includes: tasking information collectors (intelligence, surveillance, and reconnaissance 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; 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)	<u>FY 2001 (\$ in Thous</u> \$1,504	ands) Developed passive exploitation signal intelligence to identify sensor reports to perform targ	on algorithm targets for s	s to enhance ituational av	the identific vareness and mize allocat	cation of tim targeting. I	e-critical tar Developed th	gets. Explo	ited informa ies to use m	tion in acous ultiple source	tic, image, and e correlation of	
(U)	 sensor reports to perform target identification and optimize allocation of sensor resources. \$1,618 Developed and demonstrated an all-source advanced capability for the detection and tracking of time-critical targets. Developed fusion systems and architectures capable of exploiting multiple sources to find, fix, identify, and track moving air and ground targets, and to detect and track targets employing camouflage, concealment, and deception techniques. Continued to develop fusion algorithms and tools to exploit fused sensor information to provide higher levels of intelligence such as enemy force structures, lines of communication, and possible courses 											
(U)	5) \$1,108 Developed and demonstrated embedded high performance processors for real-time knowledge and information-based processing to achieve exploitation and rapid fielding of an affordable fusion capability for all-source intelligence surveillance and reconnaissance data. Demonstrated a four times affordability improvement in embedded high performance processing through a reduction in size, weight, and power, thereby reducing the system footprint and cost of deployed systems. Demonstrated a two times improvement in high performance computing software affordability through the continued maturation of software standards, such as Vector Signal Image Processing Library and Message Processing Interface, which serve to protect the software investment over hardware generations.											
Р	roject 4072			Page	3 of 17 Pag	es			Ex	hibit R-2A	(PE 0603789F)	

	RD	T&E BUDGET ITEM JUSTIFICA	TION SHEET (R-2A Exhibit)	DATE February 2002							
вирс 03 -	GET ACTIVITY	Technology Development	PE NUMBER AND TITLE 0603789F C3I Advanced Developmer	PROJECT 1t 4072							
(U)	A. Mission Des	scription Continued									
(U) (U)	FY 2001 (\$ in Thousands) Continued \$2,915 Continued to develop advanced fusion technology to evaluate the capability of Unmanned Combat Aerial Vehicles to operate in a Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) data-rich environment as part of an integrated Command, Control, Communications (C3) network. Developed and demonstrated command and control (C2) technologies for the dynamic C2 of multiple vehicles under a highly dynamic mission environment. Developed and demonstrated, through simulation, the software elements for both the air vehicle and Mission Control Station required for the dynamic C2 of multiple vehicles.										
(U)	\$2,266	Developed and demonstrated technologies data-rich environment as part of an integrat Station and UCAV air vehicle. State-of-the	to support the affordable Unmanned Combat Aerial Vehicle unit ted C3 network. Initiated the integration of the C2 software eleme e-art tools were used to maximize the reuse of software componer	recurring flyaway goal in a C4ISR ents into the Mission Control nts.							
(U)	\$9,411	Total									
(U)	FY 2002 (\$ in 7	<u>Thousands)</u>									
(U)	\$3,341	Develop and demonstrate advanced signal time-critical targets, and information extrac from acoustic, image, and signal intelligence events and their relationships from free for effort was accomplished in PE 0603726F, I	and data exploitation technologies for detection, tracking, identification technologies for situational awareness. Develop tools to extract ce. Continue to develop and demonstrate information extraction to m text, allowing the warfigther more time to perform analysis. (Propect 2810.)	cation, and targeting of ract information from data derived ools that automatically extract rior to FY 2002, a portion of this							
(U)	\$6,519	Develop and demonstrate advanced data an models, and automated fusion process man and tracking of time-critical targets. Contin identify, and track moving air and ground t techniques. Continue to develop fusion alg enemy force structures, lines of communica PE 0603726F, Project 2810.)	ad information fusion capabilities to support multi-source mission agement. Continue to develop and demonstrate an all-source adv nue to develop fusion systems and architectures capable of exploit argets, and to detect and track targets employing camouflage, con gorithms and tools to exploit fused sensor information to provide h ation, and possible courses of action. (Prior to FY 2002, a portion	s, new sensor types, cognitive anced capability for the detection ting multiple sources to find, fix, acealment, and deception higher levels of intelligence such as a of this effort was accomplished in							
(U)	\$1,268	Develop and demonstrate advanced data ha capabilities to access, extract, process, and event and motion pattern recognition tools probabilistic approaches for accumulation of	andling and event visualization technologies. Continue to develop display fused multi-source intelligence for near-real-time situatio for analysis, visualization and decision aids to detect enemy activ of data/information to support target/activity identification and sit	and demonstrate automated nal awareness. Develop timeline, ity. Develop and demonstrate tuation awareness. Initiate							
Р	roject 4072		Page 4 of 17 Pages	Exhibit R-2A (PE 0603789F)							
	RDI	DATE	February 2002								
---------------------	--	--	--	-------------------------	-------------------------	--	--	--	--		
BUDC 03 -	GET ACTIVITY Advanced T	echnology Development	PE NUMBER AND TITLE 0603789F C3I Advanced De	evelopment	PROJECT 4072						
(U)	A. Mission Desc	ription Continued									
(U)	FY 2002 (\$ in Th	<u>ousands) Continued</u> development of a capability for precise geo- technologies to use multiple source correlation	location and identification of targets exploiting mu	lti-sensor data. Contin	ue to develop the s.						
(U)	\$11,128	Total		C							
(U) (U)	FY 2003 (\$ in Thousands) \$4,168 Develop and demonstrate advanced signal and data exploitation technologies for detection, tracking, identification, and targeting of time-critical targets, and information extraction technologies for situational awareness. Develop tools to extract information from data derived from image, and measurement and signature intelligence. Continue to develop and demonstrate information extraction tools that automatically extract events and their relationships from free form text, allowing the warfighter more time to perform analysis										
(U)	\$8,928	\$8,928 Develop and demonstrate advanced data and information fusion capabilities to support multi-source capabilities, new sensor types, cognitive models, and automated fusion process management. Continue to develop and demonstrate an all-source advanced capability for the detection and tracking of time-critical targets. Demonstrate fusion systems and architectures capable of exploiting multiple sources to find, fix, identify, and track moving air and ground targets, and to detect and track targets employing camouflage, concealment, and deception techniques. Continue to develop fusion algorithms and tools to exploit fused sensor information to provide higher levels of intelligence such as enemy force structures, lines of communication, and possible courses of action. Initiate collaborative collection and fusion of intelligence,									
(U)	 \$2,997 Develop and demonstrate advanced data handling and event visualization technologies. Continue to develop and demonstrate automated capabilities to access, extract, process, and display fused multi-source intelligence for in-time situational awareness. Continue development of tools for timeline, event, and motion pattern recognition to support analysis, visualization, and decision aids to detect enemy activity. Continue to develop probabilistic approaches for accumulation of data/information to support target/activity identification and situational awareness. Develop a capability for precise geo-location and identification of targets exploiting multi-sensor data. Continue to develop the technologies to use multiple source correlation of sonsor resources. 										
(U)	\$16,093	Total									
(U)	B. Project Chan Not Applicable.	<u>ge Summary</u>									
Р	roject 4072		Page 5 of 17 Pages	Exhib	oit R-2A (PE 0603789F)						
	471										

RDT&E BUDGET ITEM JUSTIFICA	DATE February 2002					
BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3I Advanced Developme	PROJECT nt 4072				
 (U) <u>C. Other Program Funding Summary (\$ in Thousands)</u> (U) Related Activities: (U) PE 0603203F, Advanced Aerospace Sensors. (U) PE 0602702F, Command, Control, and Communications (C3). (U) PE 0603742F, Combat Identification Technology. (U) This project has been coordinated through the Reliance process to 	harmonize efforts and eliminate duplication.					
(U) <u>D. Acquisition Strategy</u> Not Applicable.						
 (U) <u>E. Schedule Profile</u> (U) Not Applicable. 						
Project 4072	Page 6 of 17 Pages	Exhibit R-2A (PE 0603789F)				
472 UNCLASSIFIED						

	RDT&	E BUDGET ITEM JU	STIFIC	ATION	SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
BUDO 03 -	BET ACTIVITY Advanced Tech	nology Development			PE NUMBE	r and title 9F C3I A	dvanced	Develop	oment		PROJECT 4216
	COST (\$ ii	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4216	Battlespace Information	ation Exchange	3,889	11,640	6,984	6,564	6,602	6,729	6,856	Continuing	TBD
(U)	A. Mission Description This project develops and demonstrates advanced communications technologies to implement a secure information grid for the worldwide information exchange of near-real-time multimedia (i.e., voice, data, video, and imagery) information in a joint/coalition environment. This secure information grid will be rapidly deployable, mobile, interoperable, and seamless between aircraft, either en-route or in theater, and command and control (C2) centers. It will: a) provide interoperability across echelon, Service, and multi-national force boundaries; b) support mobile C2, sensor-to-shooter operations, and the battle management decision process; and c) provide in-transit visibility of en-route aircraft, cargo, mission status, and reachback capabilities for aircraft to CONUS operations centers (i.e., updating information and mission changes to en-route aircraft). Technology developments include an information assurance decision support system, advanced information management, multi-level secure communications, secure survivable networks, and communications transmission systems.										
(U) (U)	<u>FY 2001 (\$ in Thous</u> \$807	<u>b in Thousands</u>) Designed, developed, integrated, and demonstrated advanced expert system decision algorithms to prioritize and control resources for global reach in a mobility environment. Continued to develop an intelligent information manager agent to throttle and regulate mission information flow among Air Mobility Command (AMC) components based on changing system capabilities. Demonstrated to AMC the capabilities to perform beterogeneous data base access and mission/user profiles under a web based erabitative.									
(U)	\$416	Designed, developed, integrat global reach in an airborne mainteach in an airborne mainteach in an airborne mainteach and an airborne mainteach an airborne mainteac	ed, and dem obility envir and radios, a	onstrated monoment. Co nd available	odular, repro ntinued to de commercial	ogrammable evelop the N system com	radio comm Iedia Access ponents into	unications te Controller	echnologies for integration ic information	for commerce ng all near-te on transport i	ial and military frm legacy AMC mechanism.
(U) (U)	\$644 \$773	Designed, developed, integrated, and demonstrated advanced protocol network and commercial management technologies to provide communications from deployed aircraft and ground elements to the AMC Tanker Airlift Control Center (TACC), as well as, in-transit visibility at the TACC of all aircraft, personnel, and cargo. Continued to develop technology to dynamically reconfigure the network and communications systems to optimally match the requirements for information transfer with changing transmission path availability. Demonstrated the capability to perform adaptive routing, quality-of-service based architecture, and smart bandwidth management. Developed and demonstrated improved communications technologies that provide reliable, efficient, secure, interoperable, and dynamic deployable communications to Air Combat Command, thus improving mission effectiveness through optimized resource management. Developed and demonstrated an Intelligent Adaptive Communications Controller system to efficiently and effectively control the use of diverse									
Р	roject 4216			Page	7 of 17 Pag	es			E>	hibit R-2A	(PE 0603789F)

	RDT&I	DATE February 2002								
BUDO		nelegy Dovelonment	PE NUMBER AND TITLE	PROJECT						
03 -	- Advanced Tech	inology Development	0603789F C3I Advanced Developmen	t 4210						
(U)	A. Mission Descript	ion Continued								
(U)	<u>FY 2001 (\$ in Thousands) Continued</u> communications media to provide increased aggregate bandwidth. Developed and integrated applications to provide mechanisms that intelligently and dynamically negotiate quality of service and bandwidth management techniques between applications and network transport services. Developed and integrated management mechanisms to provide dynamic, intelligent, management, and control of information system resources.									
(U)	\$462	Developed and demonstrated intelligent networking tea with a greatly reduced footprint. Continued to develop demonstrated user-friendly, assured multiband and wice its environment and service demands, as well as detect	chnology to provide assured, seamless, battlespace con a capability to support a multilevel secure information leband wireless intelligent networking capability that a s, protects, and reacts against intrusion and disruption of	nectivity to the aerospace forces a system manager. Developed and automatically senses and adapts to of service.						
(U)	\$787	Developed and demonstrated theater battle managemen operational decision support and rapid response capabi impact decision aid capability. Developed master caut	nt and time-critical air operations technologies to provi lities. Completed weather impact decision aid capabili ion panel capability to centrally monitor and manage c	de field commanders essential ity and developed space weather command and control assets.						
(U)	\$3,889	Total								
(U)	FY 2002 (\$ in Thous	ands)								
(U)	\$1,234 Develop, integrate, and demonstrate advanced expert system decision algorithms to prioritize and control resources for global reach in a mobility environment. Demonstrate an intelligent information manager agent that will throttle and regulate mission information flow among Air Mobility Command (AMC) components based on changing system capabilities. Integrate in an AMC airlifter the airborne components of Intelligent Information Manager (IIM), Integrated Network Controller (INC), and the Global Media Access Controller (GMAC) to produce a combined commercial/military global communications system, a dynamically switched network, and an intelligent heterogeneous database									
(U)	\$1,206 Develop, integrate, and demonstrate advanced network protocols and commercial management technologies to provide communications from deployed aircraft and ground elements to the AMC Tanker Airlift Control Center (TACC), as well as, in-transit visibility at the TACC of all aircraft, personnel, and cargo. Demonstrate technology to dynamically reconfigure the network and communications systems to optimally match the requirements for information transfer with changing transmission path availability. Integrate and demonstrate the ground-based components of the IIM, INC, and GMAC in AMC's TACC and AMC's forward deployed unit, the Tanker Airlift Control Element, resulting in a seamless information infrastructure providing total asset visibility and enhanced situation awareness.									
(U)	\$696	Develop and demonstrate improved global networking	and resource management technologies that provide re-	liable, efficient, secure,						
Р	Project 4216	Page	8 of 17 Pages	Exhibit R-2A (PE 0603789F)						

	RDT	DATE	February 2002					
BUDO			PE NUMBER AND TITLE	Development	PROJECT			
03 -	Advanced le	chnology Development	0603789F C3I Advanced	Development	4216			
(U)	A. Mission Descri	ption Continued						
(U)	FY 2002 (\$ in Tho	usands) Continued interoperable, and dynamic deployable comm adaptive communications controller system(s Continue development of mechanisms that in Control (C2) applications and network transp capabilities and incorporate additional manage	nunications to Air Combat Command. Continue and to integrate additional and emerging meditely and dynamically negotiate quality of port services. Continue development of affordate the services affect commander's com-	te to develop the ability to lia types for increased ban of service and bandwidth b ble multi-level secure network trol of all information grid	manage and control dwidth capabilities. between Command and work management			
(U)	\$1,379	Develop and demonstrate intelligent wireless while reducing the forward-deployed footprin the worldwide exchange of near-real-time mu intelligent bandwidth management concepts	networking technologies to provide seamless a nt. Develop and demonstrate technology to sup iltimedia (i.e., voice, data, video, and imagery) and militarized protocols for highly dynamic an	and assured connectivity to oport an en-route and in-th O. Continue to develop and ad-hoc wireless networ	o all aerospace forces leater information grid for d demonstrate dynamic k topologies.			
(U)	\$1,191	Develop and demonstrate theater battle mana operational decision support and rapid respon develop master caution panel capability to ce process. Develop interface methodologies for information environment.	gement and time-critical air operations technol use capabilities. Continue to develop space we ntrally monitor and manage command and con r seamless integration of theater battle manage	logies to provide field com ather impact decision aid of trol assets within the air of ment applications into the	manders essential capability. Continue to perations center C2 joint battlespace			
(U)	\$2,934	Develop and demonstrate an information asso intrusion detection, intrusion response, and in large-scale coordinated attacks, and provide a Information Protection Technologies that will reconstitute not only the system but also the	arance decision support system to provide real aformation system recovery. Develop data corr automatic forensics analysis of attack informati l allow systems to tolerate adversary attacks an critical processes, programs and data.	time defensive courses-of- relation and data fusion to ion. Develop and demons- nd intrusions, gracefully de	-action relating to ols for detection of trate Adaptive egrade, recover and			
(U)	 \$3,000 Bevelop and demonstrate Information Hiding, Steganography and Digital Watermarking for Information Protection and Authentications Systems. Develop stegongraphic algroithms that detect if infomation and information systems have been tampered with and demonstrate this Capability, in Air Force operational systems 							
(U)	\$11,640	Total						
Р	roject 4216		Page 9 of 17 Pages	Exhib	bit R-2A (PE 0603789F)			
			175					

	RDT	DATE February 2002					
BUD0 03 -	GET ACTIVITY • Advanced Te	echnology Development	PE NUMBER AND TITLE 0603789F C3I Advanced Developme	PROJECT			
(U)	A. Mission Desci	ription Continued					
(U) (U)	<u>FY 2003 (\$ in Th</u> \$1,295	ousands) Develop, integrate, and demonstrate advance mobility environment. Continue to demons flow among AMC components based on ch components of Intelligent Information Man combined commercial/military global comm access interface to prioritize and control res	ced expert system decision algorithms to prioritize and control r strate an intelligent information manager agent that will throttle hanging system capabilities. Continue to integrate in an Air Mo hager, Integrated Network Controller, and the Global Media Acc munications system, a dynamically switched network, and an in sources in a mobility environment.	esources for global reach in a and regulate mission information bility Command airlifter the airborne cess Controller to produce a telligent heterogeneous database			
(U)	\$1,304	Develop, integrate, and demonstrate advance deployed aircraft and ground elements to the visibility at the TACC of all aircraft, persor communications systems to optimally matce to integrate and demonstrate the ground-base Media Access Controller in AMC's TACC information infrastructure providing total as	ced network protocols and commercial management technologic ne Air Mobility Command (AMC) Tanker Airlift Control Center nnel, and cargo. Continue to demonstrate technology to dynami th the requirements for information transfer with changing trans sed components of the Intelligent Information Mannager, Integr and AMC's forward deployed unit, the Tanker Airlift Control E sset visibility and enhanced situation awareness.	es to provide communications from r (TACC), as well as, in-transit cally reconfigure the network and mission path availability. Continue rated Network Controller, and Global lement, resulting in a seamless			
(U)	\$1,000	Develop and demonstrate improved global interoperable, and dynamic deployable com system(s), integrating additional and emerg mechanisms that intelligently and dynamica based on mission priorities. Complete deve with status and control of information grid	networking and resource management technologies that provide munications to Air Combat Command. Complete the adaptive ing media types for increased bandwidth capability. Continue of ally negotiate quality of service and bandwidth between applica elopment of affordable multi-level secure network management network resources.	e reliable efficient, secure, communications controller levelopment and integration of tions and network transport services capabilities to provide commanders			
(U)	 U) \$1,411 Develop and demonstrate intelligent wireless networking technologies to provide seamless and assured connectivity to all aerospace forces while reducing the forward-deployed footprint. Continue to develop and demonstrate technology to support an en-route and in-theater information grid for the worldwide exchange of near-real-time multimedia (i.e., voice, data, video, and imagery). Develop and demonstrate havond line of eight widehand technologies between eighterne platforms and ground terminals. 						
(U)	\$1,008	Develop and demonstrate theater battle man operational decision support and rapid resp and manage command and control (C2) ass network technologies that provide the capal	nagement and time-critical air operations technologies to provid onse capabilities. Complete development and demonstrate tech ets within the air operations center C2 process. Develop and de bility to monitor, understand, and maintain the status of distribu	e field commanders essential nologies that integrate, illuminate, monstrate advanced application and ted C2 weapon systems. Continue			
Р	roject 4216		Page 10 of 17 Pages	Exhibit R-2A (PE 0603789F)			
			476				

	RDT&	DATE February 2002							
BUD		nology Dovelopment		PROJECT					
03	- Advanced Tech		0603789F C3I Advanced Developmen	10 4210					
(U)	A. Mission Descript	ion Continued							
(U)	FY 2003 (\$ in Thous	ands) Continued development of interface methodologies for seamless i infosphere.	ntegration of theater battle management applications in	nto the joint battlespace					
(U)	\$966 Develop and demonstrate an information assurance decision support system to provide real-time defensive courses-of-action relating to intrusion detection, intrusion response, and information system recovery. Demonstrate data correlation and data fusion tools for detection of large-scale coordinated attacks, and provide automatic forensics analysis of attack information. Develop the capability to assess attacks and sophistication of the threat level against the mission. Initiate development and demonstration of automated deployment of defensive counter measures								
(U)	\$6,984	Total							
(U)	<u>B. Project Change S</u> Not Applicable.	Summary							
(U) (U) (U) (U)	C. Other Program I Related Activities: PE 0602702F, Comm This project has been	Funding Summary (\$ in Thousands) and, Control, and Communications (C3). coordinated through the Reliance process to harmonize	efforts and eliminate duplication.						
(U)	D. Acquisition Strat Not Applicable.	egy							
(U) (U)	E. Schedule Profile Not Applicable.								
F	Project 4216	Page	1 of 17 Pages	Exhibit R-2A (PE 0603789F)					

	RDT&E BUDGET ITEM J	USTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	iry 2002
вира 03 -	GET ACTIVITY - Advanced Technology Developmen	t		PE NUMBE 060378	R AND TITLE	dvanced	Develop	oment		PROJECT 4872
	COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4872	Dynamic Aerospace C2 & Execution	4,952	7,436	9,303	11,549	11,963	11,757	11,717	Continuing	TBD
(U)	A. Mission Description In order to perform command, control, and execution for the Expeditionary Aerospace Force (EAF), the Air Force must be able to plan, assess, monitor, and replan missions rapidly in a dynamic environment. This project develops and demonstrates technologies necessary for dynamic command and control (C2) decision making. It provides the technology and demonstrations needed to enable the warfighter to plan, assess, execute, monitor, and replan on the compressed time scales required for tomorrow's conflicts, whether they be combat or operations other than war. It will develop and demonstrate a new generation of planning assessment technologies that enable a new paradigm of effects-based operations, allowing the aerospace commanders to determine the desired operational effects and prosecute the mission accordingly. It will develop innovative capabilities capable of realizing a strategy to task approach to aerospace warfare exploiting a link between command, strategy, and assessment functions. It will develop and demonstrate distributed C2 technologies that provide the commander and staff with seamless access to tailored multi-media, multi-spectral data within a mobile, dynamic C2 center. Knowledge-based intelligent information technologies will be developed to support robust, real-time, large-scale Air Force C2 systems. The resultant products of the project will be the capabilities required to dynamically plan and execute missions, which is a key component of battlespace infosphere concept set forth in the Air Force Scientific Advisory Board Reports, 'Information Management to Support the Warrior' and									
(U) (U) (U)	FY 2001 (\$ in Thousands)\$1,373Developed and demonstrate commanders to determine to through active template tect managers in time to achieve near-real-time dynamic site\$1,594Developed and demonstrate multi-media, multi-spectral defensive, and support elem assessment. Developed and demonstrate point force battle plan simulti-\$1,985Developed and demonstrate multi-media, multi-spectral point force battle plan simulti-	ed an effects-b he desired open nologies to p e mission obje ation assessm ed distributed data for comments into an a l integrated m ation, assessm ed knowledge-	ased approad erational effe rovide recon ctives. Deve ent, and iden C2 technolog nanders and erospace cor ulti-user coll nent, and imp based intelli	ch for the ne cts at the rig nmended pri eloped and d tify preferre gies that are staff within nmand cente aborative in olementation gent informa	xt generation th place at the orities, resource emonstrated ad courses of scalable and mobile, dyna er that provide teraction tech focused on ation tools to	n of planning ne right time irce availabi model abstr action for d reconfigura amic C2 cen les the EAF hnology for aerospace op o support rob	g and assess Developed lity, and pro- raction to rep ecision mak ble and pro- ters. Develo a cohesive e adaptive vis perations. ust, real-tim	ment technic d the effects- vide the info olicate/replay ing, while pr vide seamles oped technol environment ualization an e, large-scal	ques that ena based opera ormation to t y military ex redicting like s access to ta logy that inte for planning nd presentati	ble aerospace tions capability he battle ercises, provide ely outcomes. ilored grates offensive, , execution, and on to enhance C2 systems.
Р	Project 4872		Page	12 of 17 Pag	ges			E>	hibit R-2A	(PE 0603789F)

	RDT	DATE	February 2002						
BUD0 03 -	GET ACTIVITY - Advanced Te	chnology Development	PE NUMBER AND TITLE 0603789F C3I Advanced E	Development	PROJECT 4872				
(U)	A. Mission Descri	ption Continued							
(U)	FY 2001 (\$ in Thousands) Continued Demonstrated knowledge-based C2 technologies in support of continuous planning and scheduling. Developed and integrated planning and information-based intelligent agents for adaptive replanning. Developed and demonstrated the capability to enhance decisions by providing commanders and decision makers a totally integrated perspective of available forces and employment options, including both operational and supporting element capabilities and limitations within an info-centric environment such as the Air Mobility Command Mobility 2000 Initiative.								
(U)	\$4,952	Total							
(U) (U)	FY 2002 (\$ in Thousands) \$1,928 Develop and demonstrate an effects-based approach for the next generation of planning and assessment techniques that enable aerospace commanders to determine the desired operational effects at the right place at the right time. Continue to develop the effects-based operations capability through active template technologies to provide recommended priorities, resource availability, and provide the information to the battle managers in time to achieve mission objectives. Continue to develop and demonstrate model abstraction to replicate/replay military exercises, provide near-real-time dynamic situation assessment, and identify preferred courses of action for decision making, while predicting likely outcomes. Develop effects-based tools to operate in the battlespace infosphere that will allow the commander and his/her staff to make decisions with uncertain, ambiguous, or vague information during the course of an air campaign. \$1,474 Develop and demonstrate distributed Command and Control (C2) technologies that are scalable and reconfigurable and provide seamless access to tailored multi-media, multi-spectral data for commanders and staff within mobile, dynamic command and control centers. Continue to develop and integrate multi-user collaborative interaction technology for adaptive visualization and presentation to enhance joint force battle plan simulation, assessment, and implementation focused on aerospace operations within the battlespace infosphere. Continue to develop and integrate soffensive, and support elements into an aerospace operations within the battlespace infosphere. Continue to develop and integrate multi-user collaborative interaction technology for adaptive visualization and presentation to enhance joint force battle plan simulation, assessment, and implementation focused on aerospace operations within the battlespace infosphere. Continu								
(U) P	\$4,034 Project 4872	manage information objects within the battlesp products, and to deliver decision-quality inform Develop and demonstrate knowledge-based in Demonstrate knowledge-based C2 technologies information-based intelligent agents for adapti management capability that will enhance decise forces and employment options, including both	pace infosphere from numerous web-enabled ir mation to any warfighter. telligent information tools to support robust, re es in support of network intrusion detection. C ive replanning. Continue to develop and demo sions by providing commanders and decision m h operational and supporting element capabiliti Page 13 of 17 Pages	aformation sources, to eal-time, large-scale a ontinue to develop ar onstrate the initial imp nakers a totally integr tes and limitations, w	o customize information aerospace C2 systems. nd integrate planning and proved integrated flight rated perspective of available <i>i</i> thin Air Mobility Exhibit R-2A (PE 0603789F)				
			479		· · · · · · · · · · · · · · · · · · ·				

	RD1	DATE February 2002						
виро 03 -	GET ACTIVITY Advanced T	echnology Development	PE NUMBER AND TITLE 0603789F C3I Advanced Developmer	PROJECT 4872				
(U)	A. Mission Desc	ription Continued						
(U)	<u>FY 2002 (\$ in Th</u>	nousands) Continued Command's info-centric environment.						
(U)	\$7,436	Total						
(U)	FY 2003 (\$ in Th	nousands)						
(U) (U)	 \$2,066 Develop and demonstrate an effects-based approach for the next generation of planning and assessment techniques that enable aerospace commanders to determine the desired operational effects at the right place at the right time. Demonstrate the effects-based operations capability through active template technologies to provide recommended priorities, resource availability, and provide the information to the battle managers in time to achieve mission objectives. Continue to develop and demonstrate effects-based tools to operate in the battlespace infosphere that will allow the commander and his/her staff to make decisions with uncertain, ambiguous, or vague information during the course of an aerospace campaign. Develop a dynamic tasking toolkit that enables the warfighter to develop a comprehensive, coherent, and integrated joint aerospace operations plan. \$2,213 Develop and demonstrate distributed Command and Control (C2) technologies that are scalable and reconfigurable and provide seamless access to tailored multi-media, multi-spectral data for commanders and staff within mobile, dynamic command and control centers. Continue to develop and demonstrate multi-user collaborative interaction technology for adaptive visualization and presentation to enhance joint force 							
(U)	 technology that integrates offensive, defensive, and support elements into an aerospace command center that provides the EAF a cohesive environment for planning, execution, and assessment. Develop embedded training technologies to provide rapid mission readiness for the warfighter. U) \$2,257 Develop and demonstrate knowledge-based intelligent information tools to support robust, real-time, large-scale aerospace C2 systems. Continue to develop and integrate planning and information-based intelligent agents for adaptive replanning. Continue to develop and 							
(U)	\$2,767	data and information required for optimal use of avai location, and status of DoD transportation assets to in Continue to develop and demonstrate the techniques from numerous web-enabled information sources, to warfighter. Develop and demonstrate data system we surveillance, and reconnaissance information systems	capabilities for mobility operations such as an improved lable mobility resources. Develop and demonstrate con nprove situational awareness to produce and manage information objects within the ju- customize information products, and to deliver decision rapper technologies to dynamically integrate disparate c s into the JBI. Evaluate and integrate core JBI informat	isearch, retrieval, and nandling of tinuous updating of the type, oint battlespace infosphere (JBI) -quality information to any ommand and control, intelligence, ion management services that				
P	roject 4872	Page	e 14 of 17 Pages	Exhibit R-2A (PE 0603789F)				

BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT 03 - Advanced Technology Development 0603789F C3I Advanced Development 4872 (U) A. Mission Description Continued enable information exchange among disparate information systems. 4872 (U) EY 2003 (5 in Thousands) Continued enable information exchange among disparate information systems. 93,303 Total (U) S. Froiect Change Summary Not Applicable. Not Applicable. 94,0000 94,0000 (U) C. Other Program Fundine Summary (5 in Thousands) (P E 0602702F, Command, Control, and Communications (C3). (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. (U) D. Acquisition Strategy Not Applicable. (U) (U) D. Acquisition Strategy Not Applicable. (U) (U) Exhibit R-2A (PE 0603789F) (U)		RDT&E BUDGET ITEM JUSTIFICATION S	DATE February 2002	
with the second seco	BUD0 03 -	GET ACTIVITY - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3I Advanced Developmer	PROJECT 4872
Not Applicable. (U) E. Schedule Profile (U) Not Applicable. Project 4872 Page 15 of 17 Pages Exhibit R-2A (PE 0603789F)	(U) (U) (U) (U) (U) (U) (U) (U)	A. Mission Description Continued FY 2003 (\$ in Thousands) Continued enable information exchange among disparate informa \$9,303 Total B. Project Change Summary Not Applicable. C. Other Program Funding Summary (\$ in Thousands) Related Activities: PE 0602702F, Command, Control,and Communications (C3). This project has been coordinated through the Reliance process to harmonize D. Acquisition Strategy	tion systems. efforts and eliminate duplication.	
Project 4872 Page 15 of 17 Pages Exhibit R-2A (PE 0603789F)	(U) (U)	Not Applicable. E. Schedule Profile Not Applicable.		
	P	Project 4872 Page	15 of 17 Pages	Exhibit R-2A (PE 0603789F)

Γ	RDT&I	E BUDGET ITEM JU	ISTIFIC		SHEET	(R-2A E	xhibit)		DATE	Februa	ry 2002
виро 03 -	GET ACTIVITY Advanced Tech	nnology Development			PE NUMBE 060378	R AND TITLE 9F C3I A	dvanced	l Develop	oment		PROJECT 4925
	COST (\$ i	n Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4925	Collaborative C2		0	3,013	1,908	2,312	1,919	1,957	1,994	Continuing	TBD
Note	: In FY 2001, efforts y	were accomplished in PE 06037	26F, Projec	t 4850.							
	This project develops and demonstrates technologies for the next generation of distributed collaborative environments, which will provide cross-disciplinary information to a decision-maker when, where, and how it is needed. Technologies developed will demonstrate advanced integrated information architectures for the near-real-time transfer of large volumes of information over existing and future command, control, and communications systems. The application of these new technologies will allow reconfiguration and adaptation of existing operational aerospace systems to support seamless integrated operations, and will facilitate an affordable implementation of the battlespace infosphere concept set forth in the Air Force Scientific Advisory Board Reports, 'Information Management to Support the Warrior' and 'Building the Joint Battlespace Infosphere.'										
(U) (U) (U)	<u>FY 2001 (\$ in Thous</u> \$0 \$0	ands) Effort was accomplished in F Total	PE 06037261	F, Project 48	50.						
(U) (U)	<u>FY 2002 (\$ in Thous</u> \$998	ands) Develop and demonstrate nex to develop collaborative techr mining: blended air/ground de	t generation ologies for	distributed split aerospa	collaborative ace operation	e environments; coalition	nts and integ warfare; sim	grated aerosp sulation-base	ace informa d acquisition	tion architec n; platform i	tures. Continue nformation
(U)	\$1,016	Develop communication technology to increase aerospace platform information transfer capacity. Continue to develop the technology to increase aerospace platform information transfer capacity for exchange of time-critical threat, sensor, and command and control information between aircraft and cooperating space, airborne, and surface communication assets. Develop the design of a high capacity, bandwidth									
(U)	\$999	Develop and demonstrate embedded information system technologies to support a transparent framework for seamless, rapid insertion of battlespace infosphere technology. Develop techniques for inserting battlespace infosphere technology that do not require a comprehensive re-test of the entire command and control (C2) system. Develop capability for modernization of aerospace and C2 platforms to support system-of-systems interoperability within the battlespace infosphere.									
P	roject 4925			Page	16 of 17 Pag	ges			Ex	hibit R-2A	(PE 0603789F)

	RDT&I	DATE February 2002								
вирс 03 -	GET ACTIVITY Advanced Tech	nology Development	PE NUMBER AND TITLE 0603789F C3I Advanced Developmen	PROJECT 4925						
(U)	U) <u>A. Mission Description Continued</u>									
(U) (U)	FY 2002 (\$ in Thousands) Continued\$3,013Total									
(U) (U)	FY 2003 (\$ in Thousands) \$255 Develop and demonstrate next generation distributed collaborative environments, and integrated aerospace information architectures. Continue to develop next generation collaborative environments, and integrated aerospace information architectures for advanced Air Force enterprises. Demonstrate technology to perform plotform information mining and collaborative environments for simulation based accuricities.									
(U)	\$906 Develop communications technology to perform information mining and control technology to increase aerospace platform information transfer capacity. Continue to develop technology to increase aerospace platform information transfer capacity exchange of time-critical threat, sensor, and command and control (C2) information between aircraft and cooperating space, airborne, and surface communication assets. Complete the design and begin the fabrication of high capacity, bandwidth efficient modem technology for point-to-point and multiple platform connectivity.									
(U)	\$747 Develop and demonstrate embedded information system technologies to support a transparent framework for seamless, rapid insertion of battlespace infosphere technology. Continue to develop techniques for inserting battlespace infosphere technology that do not require a comprehensive re-test of the entire C2 system. Continue to develop capability for modernization of aerospace and C2 platforms to support system-of-systems interoperability within the battlespace infosphere.									
(U)	B. Project Change Summary Not Applicable.									
(U) (U) (U) (U)	 U) <u>C. Other Program Funding Summary (\$ in Thousands)</u> U) related Activities: U) PE 0602702F, Command, Control, and Communications (C3). U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. 									
(U)	D. Acquisition Strategy Not Applicable.									
(U) (U)	<u>E. Schedule Profile</u> Not Applicable.									
Р	roject 4925		Page 17 of 17 Pages	Exhibit R-2A (PE 0603789F)						

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)						DATE	DATE February 2002		
BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603876F Space Based Laser								PROJECT 4779
COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4779 Space Based Laser	67,522	0	0	0	0	0	0	0	136,447
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

In FY 2002, efforts were transferred to Ballistic Missile Defense Organization (BMDO).

(U) <u>A. Mission Description</u>

The Space Based Laser (SBL) project was created to investigate the feasibility of providing the nation with a highly effective, continuous, global boost phase intercept option for both national and theater missile defense. An SBL system could defend against missiles without putting the lives of US military personnel at risk. The speed of light defense allows for boost phase intercept at the earliest possible moment, offering the highest probability that intercepted missile fragments (possibly containing active chemical/biological or nuclear materials) will fall within the attacker's territory rather than defended territory. The SBL system could also provide many ancillary mission capabilities, including space control, air defense, global surveillance, and target detection and designation. Beginning with the FY02 budget, all SBL activities and associated funding are transferred to BMDO.

The SBL project is structured to research the feasibility and operational contribution of performing boost phase missile defense from space. The Ballistic Missile Defense Organization (BMDO) directed energy program (Project 1360, PE 0603173C in FY 2000, PE 0603174C in FY 2001 and out) has been addressing several key critical technology issues, such as the Hydrogen Fluoride laser performance and modeling; optics experiments; laser and optics integration; and Acquisition, Tracking, Pointing, and Fire Control (ATP/FC) tests. The combined AF/BMDO budget ends with FY01 funding and for FY02 and out, all funds transfer to BMDO who will fund through space flight testing. The Integrated Flight Experiment (IFX) is a critical step in proving the feasibility of destroying ballistic missiles in their boost phase from space.

Technology risk reduction and component demonstration prior to flight hardware development are important parts of the IFX program. Ground experiments will demonstrate major risk area engineering design units (gain generator, resonator, beam control). The IFX will culminate with space vehicle integration, performance of a series of on-orbit experiments, and demonstration of SBL boost phase intercept feasibility.

The Air Force contributed funds to the Space Based Laser project from FY 1999 - FY2001. This project is classified as Budget Activity 3 because the Integrated Flight Experiment (IFX) is a technology demonstration.

Project 4779	Page 1 of 3 Pages	Exhibit R-2 (PE 0603876F)
	485 UNCLASSIFIED	

	RDT&E BUDGET ITEM JUSTIFICAT	DATE Februa	DATE February 2002				
BUD	BUDGET ACTIVITY PE NUMBER AND TITLE				PROJECT		
03 -	- Advanced Technology Development	U603876F Space Ba	sed Laser		4779		
(U)	A. Mission Description Continued						
(U) (U) (U) (U) (U) (U)	FY 2001 (\$ in Thousands)\$59,821Continued IFX Development\$500Continued Advanced Mirror System Developm\$250continued Lethality, Analysis & Architecture (\$\$6,950Provided IFX Program Support\$67,521Total	nent (AFSPC and AFRL efforts)					
(U) (U) (U)	FY 2002 (\$ in Thousands)\$0No activity - Program transferred to BMDO ef\$0Total	fective in FY02					
(U) (U) (U)	FY 2003 (\$ in Thousands)\$0No Activity - Program transferred to BMDO e\$0Total	ffective FY02					
(U)	B. Budget Activity Justification This PE is in Budget Activity 3 (Advanced Technology Development Integrated Flight Experiment (IFX).	t) because it is performing technology	development and ris	sk reduction activities	on the path to an		
(U)	C. Program Change Summary (\$ in Thousands)						
		<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>		
(U)	Previous President's Budget	72,544	0	0	TBD		
(U)	Appropriated Value	73,216	0				
(U)	Adjustments to Appropriated Value	510					
	a. Congressional/General Reductions	-513					
	b. Small Business Innovative Research	-5,023					
	d. Balow Thrashold Paprogram						
	e. Rescissions	-159					
ധ	Adjustments to Budget Years Since FY 2002 PBR	-137					
				.			
F	Project 4/79	Page 2 of 3 Pages		Exhibit R-2	(PE 0603876F)		
		486					

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE Febru	DATE February 2002	
BUDGET ACTIVITY PE NUMBER 03 - Advanced Technology Development 0603876			TLE ace Ba	sed Laser		PROJECT 4779	
(U)	C. Program Change Summary (\$ in Thousands) Continued	FY	2001	FY 2002	FY 2003	Total Cost	
(U)	Current Budget Submit/FY 2003 PBR	67	,521	0	0	TBD	
(U)	Significant Program Changes: FY01: \$10M congressional add in FY 2001 to support acceleration of t FY02 and out: All funds transferred to BMDO	the IFX and its integrated	test facilit	y (included under II	FX development).		
(U) (U)	D. Other Program Funding Summary (\$ in Thousands) RDT&E, BMDO, R-29, Support Technologies-Adv Tech Dev						
(U)	<u>E. Acquisition Strategy</u> Not Required						
(U) (U)	F. Schedule Profile Not Required						
F	roject 4779	Page 3 of 3 Pages			Exhibit R-2	(PE 0603876F)	

THIS PAGE INTENTIONALLY LEFT BLANK