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

DATE: February 2000

BUDGET ACTIVITY: 04 - Demonstration and Validation

PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D

PROJECT: 64NATO

| COST ($ in Thousands) | | FY 1999 Actual | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | FY 2004 Estimate | FY 2005 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| 64NATO | Nato Coop R&D | 3,956 | 4,222 | 5,509 | 11,685 | 11,885 | 12,123 | 12,363 | Continuing | 21,257 |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**(U) A. Mission Description**

These funds will be used to help implement international cooperative research, development, and acquisition (ICRD&A) agreements with NATO and major non-NATO allies (Australia, Egypt, Israel, Japan, and Korea). The program implements the provisions of Title 10 U.S. Code, Section 2350a on NATO Cooperative Research and Development (R&D). The program was established to improve cooperation among NATO nations, and later major non-NATO allies, in research, development, and production. The legislation authorized funds to significantly improve US and allied conventional defense capabilities by leveraging the world's best defense technologies, eliminating costly duplication of research and development efforts, accelerating the availability of defense systems, and promoting US and allied interoperability or commonality. Starting in FY00 these funds will focus on implementing coalition warfare technology and demonstrations that address Air Force space, command, control, communications, intelligence, surveillance, and reconnaissance (C3ISR), modernization and readiness needs in support of the National Military Strategy, Joint Vision 2010, and the Air Force's Strategy of Global Engagement. The planned program is shown below. The final program will be reported separately as required by Title 10 U.S. Code, Section 2350a(f). This program element funds the implementation of Air Force ICRD&A agreements in (1) Basic Research (2) Applied Research (3) Advanced Technology Development (4) Demonstration and Validation (5) Engineering and Manufacturing Development and (6) RDT&E Management Support.

(U) FY 1999 ($ in Thousands)

(U) $195 Effects of the Ionosphere on Command, Control, Communications, and Intelligence (C3I) Systems (Air Force Research Laboratory (AFRL)/United Kingdom (UK)) - Cooperative project to leverage complementary ionospheric sensors and data to develop capabilities for timely warning of ionosphere disturbances that disrupt C3I systems. In FY 99 the project installed ionospheric sensors on Guam to expand the coverage area for which C3I system outage forecasts and alerts can be provided; and the concept of a ground-based, rapidly deployable, Space Weather Station (SWS), employing multiple sensors and battlespace environment models to specify ionospheric and radio wave propagation conditions, was demonstrated in a field program on Ascension Island.

(U) $106 Free Piston Shock Tunnel (FPST)/High Enthalpy Goettingen Project (HEG) (Arnold Engineering and Development Center (AEDC)/Germany) - Cooperative project to significantly reduce the cost of acquiring technologies and ground test capabilities for the development of hypersonic flight systems by combining the complementary efforts of the US FPST and Germany's HEG facilities. In FY 99 the project tested the FPST and the HEG. Data reduction from the test entries was largely completed. Analyzed data on computational fluid dynamics (CFD), and CFD code development was accomplished. The final report has been drafted.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 2000 |
|---|---|
| BUDGET ACTIVITY<br>04 - Demonstration and Validation | PE NUMBER AND TITLE<br>0603790F NATO Cooperative R&D |
| PROJECT<br>64NATO | |

**(U) A. Mission Description Continued**

(U) FY 1999 ($ in Thousands) Continued

(U) $1,000 Dense Metal Case Penetrating Weapon (DMCPW) (AFRL/UK) - Cooperative project to develop and demonstrate technology for a dense metal penetrating warhead. This technology offers a two-fold increase in hard target penetration over current warhead case designs. The warhead will be compatible for carriage and release with future smaller aircraft, and stand-off weapons such as cruise missiles. Technology demonstration will be through sub-scale and full-scale dynamic ground impact testing (sled and/or powder gun). In FY 99 the project completed the DMCPW warhead detailed design, development, and fabrication of scaled/full scaled penetrator designs for the test program which will be accomplished in FY 00.

(U) $250 Cooperative Research and Development Efforts in Imaging Spectrometer Development (AEDC/Canada) - Cooperative project to pool the spatial and spectral advances of both the US and Canada, and develop a high-resolution sensor system capable of characterizing signatures of rockets and aircraft, for drug interdiction, and identifying trace quantities of a broad spectrum of gases in the environment. In FY 99 the project investigated data collection issues associated with imaging spectroscopy. Prototype data collection and analysis was accomplished.

(U) $100 Metal Matrix Composites (MMCs) for Aerospace Applications (AFRL/UK) - Cooperative project to improve the properties and processing of silicon carbide (SiC) -reinforced Titanium (Ti) - alloy and Aluminum (Al) - alloy metal matrix composites for aerospace applications. In FY 99, the relationships between the structure and properties of carbon coatings were determined. Coating deposition parameters were defined. Carbon coated SiC fibers were produced by the UK and evaluated by the AFRL. Transverse testing of matrix-coated fibers were completed and specification of matrix-coated fibers were defined. A joint project to improve the mechanical properties of SiC-reinforced Al was defined and initiated.

(U) $105 Refractive Turbulence (AFRL/Australia) - Cooperative project to investigate specific and potential refractive turbulence-induced mission-limiting performance degradations on airborne military microwave radar surveillance, infrared (IR) laser and IR/microwave long range communication systems. The data reduction analysis and modeling of refractivity and turbulence measurements is essential to support studies that evaluate atmospheric refraction propagation effects on the design/performance of the Airborne Laser (ABL). In FY 99 the project supported data reduction and analysis of aircraft turbulence measurements in both Japan/Korea and Australia winter jetstreams.

(U) $200 Integrated Tactical Aircraft Control (ITAC) Program (AFRL/France) - Cooperative project to develop, integrate and demonstrate critical flight control and flight management technologies that enable cooperative flight operations of a package compromised of manned and uninhabited combat air vehicles (UCAVs). The cooperative control architecture enables management and control of an integrated strike package by the aircrews in the combat aircraft. In FY 99 the project completed system level definition and intiated detailed design. The design approach is based on software agents. Twenty seven software agents were identified and development responsibilities assigned. The functional descriptions and initial input/output (I/O) definitions were defined for each agent. A common scenario was developed. Flight control algorithms, situation assessment methods, flight management and health monitoring system requirements were identified.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 2000 |
|---|---|
| BUDGET ACTIVITY<br>04 - Demonstration and Validation | PE NUMBER AND TITLE<br>0603790F NATO Cooperative R&D |
| PROJECT<br>64NATO | |

**(U) A. Mission Description Continued**

(U) FY 1999 ($ in Thousands) Continued

(U) $300 Anthropometric Accommodation in Crew Systems (AFRL/The Netherlands) - Cooperative project to establish (a) a collection of three-dimensional (3-D) anthropometric data which accurately and consistently describes the variability of men and women in both Europe and the US; (b) high quality methods for accommodation and interoperability assessment of crew systems; and (c) method for combining the database with the assessment methods to assure accommodation and interoperability is achieved in the design process. In FY 99 the project finished 75% the US 3-D data collection and 25% of the European and initiated the augmented reality assessment of the aircraft crewstations.

(U) $700 Advanced Hybrid Propulsion Technologies Cooperative Research Project (AFRL/Japan) - Cooperative project to develop hybrid propulsion technology for air-to-air missiles. In FY99 the project developed the subsystem components necessary to meet the overall project requirements of increased performance and safety, as well as providing energy management capability. The subsystem components include an injector, gas generator pressurization system, flow control valve, liquid oxidizer expulsion system, oxidizer chemistry development, and oxidizer tankage.

(U) $1,000 Advanced Crew Ejection Seat (ACES) II - Ejection Seat Cooperative Modification Project (Human Systems Center (HSC)/Japan) - Cooperative project to develop and design a modification kit that can be retrofitted to the ACES II ejection seat to increase safety and survivability of light weight aircrew members by: increasing seat stability; increasing seat/accommodation range; and adding limb restraints. ACES II ejection seat improvements include a gender free operational capability to assure equally reduced mortality rate and serious injuries for male and female aircrew members. The completion of this program is intended to reduce the number of fatalities and serious injuries for all weight classes during high speed ejections and increase anthropometric range for aircrew population requirements. The design stages were completed and the qualification program will be initiated in FY 00.

(U) $3,956 Total

(U) FY 2000 ($ in Thousands)

(U) $213 Effects of the Ionosphere on C3I Systems (AFRL/UK) - Cooperative project to leverage complementary ionospheric sensors and data to develop capabilities for timely warning of ionospheric disturbances that disrupt C3I systems. In FY 00 a prototype ground-based SWS, employing multiple sensors and multiple battlespace environment models to specify ionospheric and radio wave propagation conditions, will be operated in the UK, to demonstrate its potential for future, in-theater support of operation C3I systems.

(U) $100 FPST/HEG Project (AEDC/Germany) - Cooperative project to significantly reduce the cost of acquiring technologies and ground test capabilities for the development of hypersonic flight systems by combining the complementary efforts of the US FPST and Germany's HEG facilities. Activities in FY 00 will include the final analysis of the data from the FPST and the HEG tests, final evaluation of non-intrusive diagnostics in the laboratory shock tunnel, and the editing and final preparation of the report.

(U) $75 Geoscience Space Mission/Cooperative Space Measurements (AFRL/Germany) - Cooperative project to fly a Department of Defense developed space plasma detector aboard a German scientific spacecraft. Joint exchange and analysis of scientific data from this mission will be used to

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | | DATE: February 2000 |
|---|---|---|
| BUDGET ACTIVITY: 04 - Demonstration and Validation | PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D | PROJECT: 64NATO |

**(U) A. Mission Description Continued**

(U) FY 2000 ($ in Thousands) Continued

develop better descriptive and predictive models of the space environment, enhancing the reliability of space-based communications and navigation capabilities for the US and its allies. In FY 99 the Flight Model of the plasma instrument was delivered to Germany for integration on board the satellite. Launch of the satellite is scheduled for FY 00.

(U) $334 Advanced Combustor Chamber Concepts Program (AFRL/France) - Cooperative project to develop and demonstrate a composite combustor structure suitable for use in advanced hypersonic weapon systems operation to Mach 8 on liquid hydrocarbon fuels. During FY 00 fabrication of a composite panel will be completed. Testing of this panel at Mach 7 flight conditions will demonstrate liquid hydrocarbon fuel-cooled operation, thus paving the way for design and testing of a complete composite combustor section. Engines that utilize this type of composite structure will be simpler, easier to cool, lower weight, and more durable than baseline metallic designs.

(U) $600 ITAC Program (AFRL/France) - Cooperative project to develop, integrate and demonstrate critical flight control and flight management technologies that enable cooperative flight operations of a package comprised of manned and UCAVs. The cooperative control architecture enables management and control of an integrated strike package by the aircrews in the combat aircraft. In FY 00 work will continue in the development of the agent/algorithms. Functional descriptions of the agents and their interrelationships will be further refined. A desktop development tool/simulation will be the initial product supporting evaluation of the design and early demonstration of it's utility.

(U) $300 Anthropometric Accommodation in Crew Systems (AFRL/The Netherlands) - Cooperative project to establish (a) a collection of three-dimensional (3-D) anthropometric data which accurately and consistently describes the variability of men and women in both Europe and the US; (b) high quality methods for accommodation and interoperability assessment of crew systems; and (c) methods for combining the database with the assessment methods to assure accommodation and interoperability is achieved in the design process. In FY 00 the project will finish both the US and the Dutch data collection, the augmented reality assessment of the aircraft crewstations, and perform accommodation effect assessments using US and Dutch data sets.

(U) $400 Aging Aircraft Life Prediction/Extension (AFRL/Australia) - Cooperative project to investigate the damage that can degrade an aircraft's service life, and develop the technology to ensure the structural integrity of aging aircraft with such damage present. This project will focus on composite patch repairs of metallic structures, widespread fatigue damage including multiple-element damage and multiple site damage, techniques for predicting the effects of corrosion and the interaction with fatigue loads, and sensors for structural health monitoring. In FY 00 the project will complete documenting experience with widespread fatigue damage and composite patch repairs, continue developing analysis techniques for corrosion/fatigue, continue evaluating composite patch repair and analysis techniques, and perform in-service evaluation of corrosion sensor.

(U) $350 Structural Integrity of Aging Aircraft (AFRL/Canada) - Cooperative project to investigate the damage that can degrade an aircraft's service life, and develop the technology to ensure the structural integrity of aging aircraft with such damage present. This project will focus on composite patch repairs for metallic structures, widespread fatigue damage, life extension techniques for metallic structures, corrosion and its interaction

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | | DATE February 2000 |
|---|---|---|
| BUDGET ACTIVITY<br>04 - Demonstration and Validation | PE NUMBER AND TITLE<br>0603790F NATO Cooperative R&D | PROJECT<br>64NATO |

**(U) A. Mission Description Continued**

(U) FY 2000 ($ in Thousands) Continued

with fatigue, structural dynamics with emphasis on weapon bay acoustics, and structural health monitoring with emphasis on sensor development. In FY 00 the project will develop analytical models for widespread fatigue damage and corrosion/fatigue, complete evaluation of composite patch repair techniques, and identify in-service dynamic problems.

(U) $250 Airworthiness of Aging Aircraft (AFRL/UK) - Cooperative project to investigate the damage that can degrade an aircraft's service life, and develop the technology to ensure the structural integrity of aging aircraft with such damage present. This project will focus on composite patch repairs for metallic structures, techniques for predicting the effects of corrosion and the interaction with fatigue loads, and structural life extension techniques for metal structures, such as the fastener-hole cold expansion process. In FY 00 the project will continue analysis techniques for corrosion/fatigue and continue developing analysis techniques for life enhancement and composite patch repairs.

(U) $250 Air Command, Control, Communications and Intelligence (C3I) Capabilities (Electronic Systems Center (ESC)/NATO Consultation, Command, and Control (C3) Agency) - Cooperative project to develop an operationally robust interface between the US Contingency Theater Automated Planning System/Theater Battle Management Core System (CTAPS/TBMCS) and NATO Initial Combined Air Operations Center (CAOC) Capability (ICC) as well as the future NATO Air Command and Control System (ACCS). This cooperative R&D effort will support air campaign planning and execution for joint and combined air operations. The scope of work to be accomplished includes advanced R&D into shared data environment, developing a concept of operation for the transfer of control between national and NATO C4I systems without interupting combat operations; and the extension of a middleware/translator product needed for the successful prosecution of a combined/joint air operation.

(U) $250 Coalition C3 Demonstration Environment (CC3DE) (AFRL/Australia, Canada) - Cooperative project to improve the efficiency of future coalition operations capabilities through the development of interoperable C3. This project will initially explore the effective management of information system resources in a coalition environment. It will develop a management architecture for the coalition environment, and develop the tools to implement this architecture. In particular, Asynchronous Transfer Mode (ATM) technology wil be integrated into a Broadband-Integrated Services Digital network (B-ISDN) in efforts to form a common international standard for networking. In FY 00 this project will attach a management node to Combined Federated Battle Lab Network (CFBLNet) in order to investigate/experiment with Coalition network management (CNM) issues.

(U) $250 Advanced Transmission Language and Allocation of New Technology for International Communication and Proliferation of Allied Waveforms (ATLANTIC PAW) (AFRL/France, Germany, UK) - Cooperative project to develop a common waveform syntax allowing for joint allied communications that will be demonstrated on programmable radio systems in each of the participating nations. Joint compliance testing commenced in FY 99 and will be completed this year with multinational communication assets to assure interoperability on a functional level. In FY 00 joint compliance testing will be conducted by using the previously designed Future Multiband Multiwaveform Modular Tactical Radio (FM3TR) waveform and newly designed multinational radio platforms. This compliance test will verify the interoperability of the basic

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | | DATE: February 2000 |
|---|---|---|
| BUDGET ACTIVITY: 04 - Demonstration and Validation | PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D | PROJECT: 64NATO |

**(U) A. Mission Description Continued**

(U) FY 2000 ($ in Thousands) Continued

equipment that is required for the Atlantic Paw effort. Modifications resulting from the compliance testing will be integrated into the international agreement. The initial design and tool characterization of the international waveform interpreter and language development will also commence in this year.

(U) $100 Space Radiation Sensors (AFRL/UK) - Cooperative project to validate the performance of a key Air Force spacecraft instrument for the measurement of space environment radiation hazards. The instrument's capability of issuing real-time space hazard warnings will be tested under a variety of conditions encountered in space aboad a joint US/UK satellite mission. In FY 00 the project will develop the preliminary space radiation data base using the US and UK instruments. Final verification of the US instrument's calibration will be performed using the preliminary data base.

(U) $250 Distributed Mission Training (DMT) Technologies (AFRL/Canada) - Cooperative project to develop DMT technologies that will enhance allied simulator based training of US and Canadian fighter aircrews and demonstrate proof of concept. DMT refers to shared training environment comprised of live, virtual, and constructive simulations allowing warfighters to train individually or collectively at all levels of war. In FY 00 the project will initiate efforts to convert and rehost CF-18 software to multi-task trainer format, and conduct visual perception and engineering research efforts to specify design requirements for ultra-high resolution visuals for DMT flight simulators.

(U) $300 Scintillation Impacts on Communication and Navigation Systems (AFRL/Australia) - Cooperative project will exchange data, deploy current sensors, develop improved sensors, and tailor current decision aids, including software, which relate to ionospheric phenomena and their effect on C3I systems. This project will provide the US critical access to data in regions of strategic interest in South East Asia and the South Pacific where large ionospheric disturbances routinely occur. FY 00 activities include the deployment of 1-2 sensors for monitoring scintillation on UHF Satellite Communication links at existing Australian sites. Real-time data retrieval will be implemented at these sites for ready data access and prototype operational support. Routine data collection will be initiated.

(U) $200 Flight Test Demonstration of Miniature Munitions Release from Internal Weapons Bay (AFRL/Australia) - This project will validate store separation simulation codes for the release of miniature munitions from internal weapons bays at both subsonic and supersonic airspeeds. The validated trajectory simulation codes will support the store certification efforts for aircraft such as the F-22, Joint Strike Fighter, and Unmanned Combat Air Vehicles. The Royal Australian Air Force (RAAF) F-111G is the only available operational fighter/bomber, with an internal bay, capable of dropping internally carried munitions at subsonic and supersonic velocities.

(U) $4,222 Total

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 2000 |
|---|---|
| BUDGET ACTIVITY<br>04 - Demonstration and Validation | PE NUMBER AND TITLE<br>0603790F NATO Cooperative R&D |
| PROJECT<br>64NATO | |

**(U) A. Mission Description Continued**

(U) FY 2001 ($ in Thousands)

(U) $200 Effects of the Ionosphere on C3I Systems (AFRL/UK) - Cooperative project to leverage complementary ionospheric sensors and data to develop capabilities for timely warning of ionospheric disturbances that disrupt C3I systems. In FY 01, a new sensing technique employing HF ionosounding data to provide (advanced) forecasts of ionospheric disturbance conditions that will affect C3I systems and operations will be demonstrated; and UK oblique High Frequency propagation data and ionospheric total-electron-content (tomography) data will be used to validate the Space Weather concept for real-time specification of the in-theater battlespace environment affecting C3I systems and operations.

(U) $400 ITAC Program (AFRL/France) - Cooperative project to develop, integrate and demonstrate critical flight control and flight management technologies that enable cooperative flight operations of a package comprised of UCAVs. The cooperative control architecture enables management and control of an integrated strike package by the aircrews in the combat aircraft. In FY 01 agent integration and development refinement will continue culminating in a real-time simulation. The man-in-the-loop evaluation & demonstration phase will begin in FY 01.

(U) $300 Anthropometric Accommodations in Crew Systems (AFRL/The Netherlands) - Cooperative project to establish (a) a collection of three-dimensional (3-D) anthropometric data which accurately and consistently describes the variability of men and women in both Europe and the US; (b) high quality methods for accommodation and interoperability assessment of crew systems; and (c) methods for combining the database with the assessment methods to assure accommodation and interoperability is achieved in the design process. In FY 01 the project will finish the European data collection, and perform accommodations effects assessments using the European data.

(U) $351 Air C3I Capabilities (ESC/NATO C3 Agency) - Cooperative project to develop an operationally robust interface between the US CTAPS/TBMCS and NATO Initial CAOC ICC and the future NATO ACCS. This cooperative R&D effort will support air campaign planning and execution for joint and combined air operations. In FY 01 work will entail: 1. producing the C2 interface between fielded systems; 2. harmonization of system data base structures as part of the shared data environment; and 3. evaluating and implementing the reuse of appropriate functional modules.

(U) $500 CC3DE (AFRL/Australia, Canada) - Cooperative project to improve the efficiency of future coalition operations capabilities through the development of interoperable C3. This project will initially explore the effective management of information system resources in a coalition environment. It will develop a management architecture for the coalition environment, and develop the tools to implement this architecture. In particular, Asynchronous Transfer Mode (ATM) technology will be integrated into a Broadband-Integrated Services Digital network (B-ISDN) in efforts to form a common international standard for networking. In FY 01 the project will integrate managment functionality being developed by individual nations into a CNM demonstrator and conduct experiments accordingly.

(U) $850 ATLANTIC PAW (AFRL/France, Germany, UK) - Cooperative project to develop a common waveform syntax allowing for joint allied communications that will be demonstrated on programmable radio systems in each of the participating nations. The waveform interpreter design will be completed in addition to the initial specifications of the waveform language. The development of both of these subsystems will

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | | DATE: February 2000 |
|---|---|---|
| BUDGET ACTIVITY: 04 - Demonstration and Validation | PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D | PROJECT: 64NATO |

**(U) A. Mission Description Continued**

(U) FY 2001 ($ in Thousands) Continued

commence jointly in each country and this will include software cost and support integration into the various host nations systems. Preliminary testing of portions of the system components will be preformed to mitigate integration risks.

(U) $658 Observations and Modeling for Space Weather (AFRL/Germany) - Cooperative project to forecast the global ionosphere and satellite drag using US and German satellite sensors and experiments to provide coordinated observations of solar impact on the space environment. In FY 01 the project will make improvements in the use of currently available sensor data to drive models of the space environment; support on-orbit operations of and analyze data from Ionospheric Occultation eXperiment (IOX); and validate algorithms intended for future use with ultraviolet operational sensor data from the Defense Meteorological Satellite Program (DMSP).

(U) $200 Space Radiation Sensors (AFRL/UK) - Cooperative project to validate the performance of a key Air Force spacecraft instrument for the measurement of space environment radiation hazards. The instrument's capability of issuing real-time space hazard warnings will be tested under a variety of conditions encountered in space abroad a joint US/UK satellite mission. In FY 01 the project will begin the development of the final radiation database. The database will be completed in FY 02.

(U) $500 DMT Technologies (AFRL/Canada) - Cooperative project to develop DMT technologies that will enhance allied simulator based training of US and Canadian fighter aircrews and demonstrate proof of concept. DMT refers to a shared training environment comprised of live, virtual, and contructive simulations allowing warfighters to train individually or collectively at all levels of war. In FY 01 the project will complete software conversion and rehost efforts, develop a DMT control station, initiate modernization enhancements and aircraft hardware/emulation integration to the CF-18 Multi-Task Training, and continue visual research and development activities.

(U) $200 Refraction and Propagation Modeling for Microwave Systems (AFRL/Australia, UK) - Cooperative project to combine a low cost refraction measurement capability and parabolic equation methods of microwave propagation modeling for evaluating refraction conditions that result in adverse performance of surveillance, communication, signal and directed energy microwave and infra-red systems.

(U) $400 Engine Component Life Extension (AFRL/Australia) - Cooperative project to develop life extension techniques and strategies that can be applied to advanced military engines. The engines involved include the US Air Force F100, -220 and -229 and F101 and Australia's TF30, F404 and T700. Much of the technology will be generic and flow from one engine to another.

(U) $400 Effects of Ionization on Hydrocarbon Combustion (AFRL/UK) - Cooperative project to investigate the effects of weak ionization on hydrocarbon-air mixture reaction time, and develop promising pilots/flameholders, including plasma ignitors which can be incorporated into scramjet engines. The research will investigate techniques to decrease the time for fuel ignition, and increase the rate of combustion to facilitate high speed propulsion. Other generic requirements to be addressed include extending the altitude range for airbreathing propulsion and providing physically smaller combustors to reduce the associated weight and cooling penalties. In FY 01 the project will complete fundamental reaction rate measurements in fast flow tube experiments, design plasma generators for burner experiments, and begin to update and improve

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | | DATE: February 2000 |
|---|---|---|
| BUDGET ACTIVITY: 04 - Demonstration and Validation | PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D | PROJECT: 64NATO |

**(U) A. Mission Description Continued**

(U) FY 2001 ($ in Thousands) Continued

computational predictive and design tools.

(U) $250 Distributed Mission Training (DMT) and Virtual Air Environment (VAE) Technologies (AFRL/Australia) - Cooperative project to develop DMT and VAE technologies that will enhance allied simulator based training of US and Australian fighter aircrews and demonstrate proof of concept. In FY 01 the project will initiate efforts to convert and rehost Australian F-18 software to multi-task trainer format, continue visual perception and engineering research efforts to specify design requirements for ultra-high resolution visuals for DMT flight simulators, and continue long-haul networking and constructive forces development activities.

(U) $300 Scintillation Impacts on Communication and Navigation Systems (AFRL/Australia) - Cooperative project will exchange data, deploy current sensors, develop improved sensors, and tailor current decision aids, including software, which relate to ionospheric phenomena and their effect on C3I systems. This project will provide the US critical access to data in regions of strategic interest in South East Asia and the South Pacific where large ionospheric disturbances routinely occur. In FY 01 data collection will continue and 1-2 additional sites will be brought on-line; characterization of ionospheric disturbances in the region and assessment of their impacts on space-based navigation, communications and surveillance systems will be conducted. An intensive multiple-diagnostic measurement campaign will be performed during active scintillation periods to enhance our understanding of the physical mechanisms leading to the development of severe equatorial disturbances.

(U) $5,509 Total

**(U) B. Budget Activity Justification**

This PE is designated in Budget Activity 4 because most of the ICRD&A projects support specific systems, include all efforts necessary to evaluate integrated

**(U) C. Program Change Summary ($ in Thousands)**

| | | FY 1999 | FY 2000 | FY 2001 | Total Cost |
|---|---|---|---|---|---|
| (U) | Previous President's Budget (FY 2000 PBR) | 4,105 | 4,283 | 5,558 | 21,257 |
| (U) | Appropriated Value | 4,117 | 4,283 | | |
| (U) | Adjustments to Appropriated Value | | | | |
| | a. Congressional/General Reductions | -12 | | | |
| | b. Small Business Innovative Research | -127 | | | |
| | c. Omnibus or Other Above Threshold Reprogram | | -34 | | |
| | d. Below Threshold Reprogram | | | | |
| | e. Rescissions | -22 | -27 | | |
| | f. Other | | | | |

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | | DATE February 2000 |
|---|---|---|
| BUDGET ACTIVITY<br>04 - Demonstration and Validation | PE NUMBER AND TITLE<br>0603790F NATO Cooperative R&D | PROJECT<br>64NATO |

**(U) C. Program Change Summary ($ in Thousands) Continued**

| | | FY 1999 | FY 2000 | FY 2001 | Total Cost |
|---|---|---|---|---|---|
| (U) | Adjustments to Budget Years Since FY 2000 PBR | | | -49 | |
| (U) | Current Budget Submit/FY 2001 PBR | 3,956 | 4,222 | 5,509 | 21,257 |

(U) Significant Program Changes:
Change Summary Explanation: N/A

**(U) D. Other Program Funding Summary ($ in Thousands)**

| | FY 1999 Actual | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | FY 2004 Estimate | FY 2005 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|

(U) N/A

(U) Related RDT&E:

(U) This program element provides ICRD&A funds for USAF Laboratory 6.1 through 6.3 programs and USAF Product, Test, and Logistics Center 6.4 through 6.5 programs. Management support for Air Force NATO Cooperative R&D PE 0603790F is funded in Air Force International Activities PE 1001004F at the level of $300 per fiscal year.

**(U) E. Acquisition Strategy**

A principal goal of the NATO Cooperative R&D program is to effectively utilize the aggregate resources invested by the US and our allies in conventional defense R&D. This program element provides the critical funding incentive needed to pursue ICRD&A agreements and helps to (a) leverage USAF and allied resources through cost sharing and economies of scale; (b) exploit the best US and allied technologies for equipping coalition forces; (c) demonstrate areas of commonality or interoperability with our allies; and (d) accelerate the availability of defense technology and systems. Candidate projects are reviewed and approved by the USD(A&T). An international agreement defining project objectives, responsibilities and costs is required prior to release of funds. To obtain these funds and ensure service commitment, projects are selected from existing or new RDT&E programs funded in the Future Years Defense Plan (FYDP). Project offices must show matching funds and contributions from associated program elements and equitable allied funding. As appropriate, funding responsibility for out-year requirements and follow-on efforts are transferred to the project office and associated program elements. Most contracts are awarded after full and open competition.

**(U) F. Schedule Profile**

| FY 1999 | FY 2000 | FY 2001 |
|---|---|---|

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | | DATE: February 2000 |
|---|---|---|
| BUDGET ACTIVITY: 04 - Demonstration and Validation | PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D | PROJECT: 64NATO |

**(U) F. Schedule Profile Continued**

| | | FY 1999 | | | | FY 2000 | | | | FY 2001 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| (U) | Effects of the Ionosphere on C3I Systems Project | | | | | | | | | | | | |
| (U) | Couple ray-trace/ionospheric model | * | | | | | | | | | | | |
| (U) | Assemble ground-based SWS | | | * | | | | | | | | | |
| (U) | Expand C3I outage alert coverage to include South Pacific sector | | | | * | | | | | | | | |
| (U) | SWS data acquisition campaign in UK | | | | | | | X | | | | | |
| (U) | Develop HF sounding technique to forecast scintillation conditions | | | | | | | | X | | | | |
| (U) | Field demonstration of HF scintillation forecasting techniques | | | | | | | | | | X | | |
| (U) | Employ UK sensor data to validate/expand SWS C3I support concept | | | | | | | | | | | | X |
| (U) | DMCPW Project | | | | | | | | | | | | |
| (U) | Preliminary design | | * | | | | | | | | | | |
| (U) | Detailed design, development, and ground testing | | | | | X | X | X | | | | | |
| (U) | System analyses and material tests | | | * | | | | X | | | | | |
| (U) | Cooperative R&D Efforts in Imaging Spectrometer Development Project | | | | | | | | | | | | |
| (U) | Preliminary design | | | * | | | | | | | | | |
| (U) | Concept checkout | | | | * | | | | | | | | |
| (U) | Brassboard Development & Checkout | | | | | X | | X | | | | | |
| (U) | Instrument Design | | | | | | | | X | | | | |
| (U) | Lab Instrument Fabrication & Checkout | | | | | | | | | | X | | X |
| (U) | Instrument Ruggedization | | | | | | | | | | | X | |
| (U) | Field Demonstration | | | | | | | | | | | | X |
| (U) | MMCs for Aerospace Application Project | | | | | | | | | | | | |
| (U) | Concept definition | | | * | | | | | | | | | |
| (U) | Produce and evaluate MMCs | | | | | | X | | | | | | |
| (U) | Specify improved MMCs | | | | | | | X | | | | | |
| (U) | Produce and evaluate improved MMC | | | | | | | | | | | X | |
| (U) | FPST/HEG Project | | | | | | | | | | | | |
| (U) | Calibration, fabrication of models, testing | * | | | | | | | | | | | |

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | | | DATE: February 2000 |
|---|---|---|---|
| BUDGET ACTIVITY: 04 - Demonstration and Validation | PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D | | PROJECT: 64NATO |

**(U) F. Schedule Profile Continued**

| | | FY 1999 | | | | FY 2000 | | | | FY 2001 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| (U) | Exchange instrumentation and diagnostic articles | * | * | | * | | X | | | | | | |
| (U) | Computational fluid dynamics code development and validation | | * | | * | X | | | | | | | |
| (U) | Exchange consultations | | | | | | | | | | | | |
| (U) | Final report | | | | * | | | X | | | | | |
| (U) | Effects of Ionization on Hydrocarbon Combustion Project | | | | | | | | | | | | |
| (U) | Agreement signed | | | | * | | | | | | | | |
| (U) | Reaction rate measurements | | | | | X | | | | | X | | |
| (U) | Design plasma generator | | | | | | | | | | | X | |
| (U) | Begin updating computational tools | | | | | | | | | | | X | |
| (U) | Geoscience Space Mission/Cooperative Space Measurements Project | | | | | | | | | | | | |
| (U) | Development and test | | * | | | | | | | | | | |
| (U) | Agreement signed | | * | | | | | | | | | | |
| (U) | Delivery to spacecraft integrator | | | | * | | | | | | | | |
| (U) | Spacecraft integration and test | | | | * | X | | | | | | | |
| (U) | Launch | | | | | | X | | | | | | |
| (U) | Data collection | | | | | | X | | | | | | X |
| (U) | Refractive Turbulence Project | | | | | | | | | | | | |
| (U) | Flight measurements | | * | | * | | | | | | | | |
| (U) | Interim Technical Reports | | | | | X | | | | X | | | |
| (U) | Field measurement reports | | * | | * | | | | | | | | X |
| (U) | Data reduction | | * | | * | | | | | | | | |
| (U) | Data analysis | | | | | | | | | | | | X |
| (U) | Advanced Combustor Chamber Concepts Project | | | | | | | | | | | | |
| (U) | Material/fabrication sample tests | | | | * | X | | | | | | | |
| (U) | Combustor cooled panel design and fabrication | | | | | X | X | | | | | | |
| (U) | Cooled panel tests | | | | | | | X | | | | | |
| (U) | Combustor chamber design & fabrication | | | | | | | | | | X | | |
| (U) | Combustor chamber tests | | | | | | | | | | | | X |

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE: February 2000 |
|---|---|
| BUDGET ACTIVITY: 04 - Demonstration and Validation | PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D |
| PROJECT: 64NATO | |

**(U) F. Schedule Profile Continued**

| | | FY 1999 | | | | FY 2000 | | | | FY 2001 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| (U) | ITAC Project | | | | | | | | | | | | |
| (U) | System definition | * | | * | | | | | | | | | |
| (U) | System design | | | * | * | | | | | | | | |
| (U) | Detailed design | | | | * | | | | X | | | | |
| (U) | System mechanization | | | | | | | | X | | X | | |
| (U) | Simulation and Evaluation | | | | | | | | | X | | | X |
| (U) | DMT Technologies Project | | | | | | | | | | | | |
| (U) | Agreement signed | | | | | X | | | | | | | |
| (U) | Program start | | | | | | | X | | | | | |
| (U) | CF-18 software conversion | | | | | | | X | | | X | | |
| (U) | Software rehost | | | | | | | X | | | | | X |
| (U) | Instructor operator control station | | | | | | | | | | X | X | X |
| (U) | CF-18 modernization enhancements | | | | | | | | | X | | | |
| (U) | Aircraft hardware/emulation integration | | | | | | | | | | | | X |
| (U) | Visual research | | | | | | | X | | | | | |
| (U) | Anthropometric Accommodation in Crew Systems Project | | | | | | | | | | | | |
| (U) | Conduct anthropometric survey | * | | | | | | | | | X | | |
| (U) | Assess subjects in actual cockpits | * | * | | | | | | | | | | |
| (U) | Assess one model in the US and one model in The Netherlands | | | * | * | | | | | | | | |
| (U) | Augmented reality assessments | | | | * | | | X | | | | | |
| (U) | 3-D data reduction | | | | | X | | X | | | | | |
| (U) | Compare live subject, computer model, and augmented reality results | | | | | | | X | X | | | | |
| (U) | Comparison of data from The Netherlands with the US | | | | | | | X | | | X | | |
| (U) | Structural Integrity of Aging Aircraft Project | | | | | | | | | | | | |
| (U) | Develop widespread fatigue damage analytical models | | | | | | X | X | X | | | | |
| (U) | Develop corrosion/fatigue analysis techniques | | | | * | | | | | X | | | |
| (U) | Evaluate composite patch analysis techniques for metallic structures | | | | * | X | X | | | | | | |
| (U) | Identify candidate solutions for dynamic control | | | * | * | X | | | | | | | |

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | | DATE: February 2000 |
|---|---|---|
| BUDGET ACTIVITY: 04 - Demonstration and Validation | PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D | PROJECT: 64NATO |

**(U) F. Schedule Profile Continued**

| | | FY 1999 | | | | FY 2000 | | | | FY 2001 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| (U) | Identify fatigue life enhancement techniques | | | | | | | X | | | | | |
| (U) | Airworthiness of Aging Aircraft Project | | | | | | | | | | | | |
| (U) | Develop life enhancement analysis techniques | | | | | | | | X | X | X | | |
| (U) | Conduct experiments | | | | | | | | X | X | | | |
| (U) | Document corrosion/fatigue service | | | | * | X | | | | | | | |
| (U) | Aging Aircraft Life Prediction/ Extension Project | | | | | | | | | | | | |
| (U) | Coordinate with US | | | * | | | | | X | | | | |
| (U) | Develop corrosion/fatigue analysis techniques | | | | * | | | | | X | | | |
| (U) | Evaluate composite patch analysis techniques for metallic structures | | | | * | X | X | | | | | | |
| (U) | Prepare for flight tests | | | | | | | X | | | | | |
| (U) | Advanced Hybrid Propulsion Technologies Cooperative Research Project | | | | | | | | | | | | |
| (U) | Detail design | * | | | | | | X | | | | | |
| (U) | Oxidizer expulsion system | | * | | * | | | | | | | | |
| (U) | Controls | | | * | | | | X | | | | | |
| (U) | Injector | | | | | | X | | | | | | |
| (U) | Pressurization system | | | | * | | | X | | | | | |
| (U) | Oxidizer development | * | | | | | | | | | | | |
| (U) | Integrate subsystems | | | | | | X | | X | | | | |
| (U) | Determine suitability for integrated testing | | | | | | | | X | | X | | |
| (U) | Conduct integrated testing | | | | | | | | | | | X | X |
| (U) | Data analysis and reporting | | | | | | | | | | | | X |
| (U) | ACES II - Ejection Seat Cooperative Modification Project | | | | | | | | | | | | |
| (U) | Detailed design | * | | | | | | | | | | | |
| (U) | Complete design | | | | | X | | | | | | | |
| (U) | Complete joint sled testing | | | | | | | | | | | X | |
| (U) | Complete USAF OT&E | | | | | | | | | | | | X |
| (U) | Space Radiation Sensors Project | | | | | | | | | | | | |

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

DATE: February 2000

BUDGET ACTIVITY: 04 - Demonstration and Validation

PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D

PROJECT: 64NATO

**(U) F. Schedule Profile Continued**

| | | FY 1999 | | | | FY 2000 | | | | FY 2001 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| (U) | Agreement signed | | | | | | X | | | | | | |
| (U) | Calibration review | | | | | | X | | X | | | | |
| (U) | Preliminary data base | | | | | | | | X | | | X | |
| (U) | Verification of calibration | | | | | | | | | | X | | X |
| (U) | Final unified data base | | | | | | | | | | | | X |
| (U) | Air C3I Capabilities Project | | | | | | | | | | | | |
| (U) | Agreement Signed | | | | | | X | | | | | | |
| (U) | Draft program and implementation plan | | | | | | | X | | | | | |
| (U) | Contract change request released | | | | | X | | | | | | | |
| (U) | Issue technical task descriptive | | | | | | X | | | | | | |
| (U) | Program definition | | | | | | | X | | | | | |
| (U) | Scope work effort to achieve shared data environment | | | | | | | | X | | | | |
| (U) | Develop translator extensions | | | | | | | | | X | | | X |
| (U) | US/NATO Battle Lab verification and development test | | | | | | | | | X | | | |
| (U) | Examine US/NATO Concept of Operations | | | | | | | | | X | | | |
| (U) | CC3DE Project | | | | | | | | | | | | |
| (U) | Agreement Signed | | | | | | | X | | | | | |
| (U) | Testbed Setup & Evaluation | | | | | X | | X | | | | | |
| (U) | Network management integration | | | | | X | | | | | | | X |
| (U) | C3I application & integration demonstration | | | | | | | | | X | | | |
| (U) | ATLANTIC PAW Project | | | | | | | | | | | | |
| (U) | Radio development | | | * | | | | | | | | | |
| (U) | Compliance testing | | | | * | X | | | | | | | |
| (U) | Agreement Review/mods signed | | | | | | | X | | | | | |
| (U) | Tool characterization | | | | | | | | X | | | | |
| (U) | Interpreter characterization/design | | | | | | | | | | X | | |
| (U) | Allied waveform coding | | | | | | | | | | | | X |
| (U) | Observations and Modeling for Space Weather Project | | | | | | | | | | | | |

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

DATE: February 2000

BUDGET ACTIVITY: 04 - Demonstration and Validation

PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D

PROJECT: 64NATO

**(U) F. Schedule Profile Continued**

| | | FY 1999 | | | | FY 2000 | | | | FY 2001 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| (U) | Agreement signed | | | | | | | | | X | | | |
| (U) | Exchange existing data | | | | | | | | | X | | | |
| (U) | Analyze existing data | | | | | | | | | | X | | |
| (U) | Test and upgrade models | | | | | | | | | | | X | |
| (U) | Support on-orbit operations of IOX | | | | | | | | | X | | | |
| (U) | Analysis on satellite data | | | | | | | | | | X | | |
| (U) | Scintillation Impacts on Communication and Navigation Systems Project | | | | | | | | | | | | |
| (U) | Agreement Signed | | | | | | X | | | | | | |
| (U) | Implement real-time data collection at existing sites | | | | | | | | | X | | | |
| (U) | Deploy scintillation monitors | | | | | | | | X | | | | |
| (U) | Correlate and calibrate data sets | | | | | | | | | | X | | |
| (U) | Characterize local disturbance climatology | | | | | | | | | | | | X |
| (U) | Campaign/complete data collection | | | | | | | | | | | | X |
| (U) | Develop regional forecast algorithms | | | | | | | | | | | X | |
| (U) | Report on regional scintillation and tailored products for C3I systems | | | | | | | | | | | | X |
| (U) | Refraction and Propagation Modeling for Microwave Systems Projec | | | | | | | | | | | | |
| (U) | Test parabolic propagation model with real refraction data | | | | | | | | | X | | | |
| (U) | Aircraft measurements: validate extreme refraction cases | | | | | | | | | X | X | | |
| (U) | Aircraft data reduction and analyses | | | | | | | | | X | X | X | |
| (U) | Validation propagation model for extreme cases | | | | | | | | | | | X | |
| (U) | Demonstrate model use with AWACS operation | | | | | | | | | | | | X |
| (U) | Final report | | | | | | | | | | | | X |
| (U) | Engine Component Life Extension Project | | | | | | | | | | | | |
| (U) | Agreement signed | | | | | | X | | | | | | |
| (U) | Engine Rotor Life Extension (ERLE) technical/economic studies | * | | | | | | X | | | | | |
| (U) | Advance life prediction methodologies for ERLE | | | | * | | | | | | | | X |
| (U) | Advanced Nondestructive Inspection/Evaluation technology | | | | | | X | | | | | | X |

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

DATE: February 2000

BUDGET ACTIVITY: 04 - Demonstration and Validation

PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D

PROJECT: 64NATO

**(U) F. Schedule Profile Continued**

| | | FY 1999 | | | | FY 2000 | | | | FY 2001 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| | development | | | | | | | | | | | | |
| (U) | Advance manufacture concepts/technical development for ERLE | | | | | | | | | | X | X | X |
| (U) | Flight Test Demo of Mini Munitions Release From Internal Weapons Bay | | | | | | | | | | | | |
| (U) | Agreement signed | | | | | | X | | | | | | |
| (U) | Logistics preparations | | | | | | X | | | | | | |
| (U) | Weapons hardware integration | | | | | | | X | | | | | |
| (U) | Operational hardware installation | | | | | | | | X | | | | |
| (U) | Flight test | | | | | | | | | X | | | |
| (U) | Final Reporting | | | | | | | | | | X | | |
| (U) | DMT & VAE Technologies Project | | | | | | | | | | | | |
| (U) | Agreement signed | | | | | | | | | | X | | |
| (U) | Program start | | | | | | | | | | | X | |
| (U) | F-18 Software Conversion | | | | | | | | | | | X | X |
| (U) | Software rehost | | | | | | | | | | | X | X |
| (U) | Visual research | | | | | | | | | | | X | X |
| (U) | Multiship network/constructive forces/coalition DMT R&D | | | | | | | | | | | X | X |

# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 2000

BUDGET ACTIVITY: 04 - Demonstration and Validation

PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D

PROJECT: 64NATO

**(U) A. Project Cost Breakdown ($ in Thousands)**

| | | FY 1999 | FY 2000 | FY 2001 |
|---|---|---|---|---|
| (U) | Effects of the Ionosphere on C3I Systems | 195 | 213 | 200 |
| (U) | FPST/HEG Project | 106 | 100 | 0 |
| (U) | DMCPW | 1,000 | 0 | 0 |
| (U) | Cooperative Research and Development Efforts in Imaging Spectrometer Development | 250 | 0 | 0 |
| (U) | MMCs for Aerospace Applications | 100 | 0 | 0 |
| (U) | Geoscience Space Mission/Cooperative Space Measurements | 0 | 75 | 0 |
| (U) | Project Refractive Turbulence | 105 | 0 | 0 |
| (U) | Advanced Combustor Chamber Concepts Program | 0 | 334 | 0 |
| (U) | ITAC Program | 200 | 600 | 400 |
| (U) | Anthropometric Accommodation in Crew Systems | 300 | 300 | 300 |
| (U) | Aging Aircraft Life Prediction/Extension | 0 | 400 | 0 |
| (U) | Structural Integrity of Aging Aircraft | 0 | 350 | 0 |
| (U) | Airworthiness of Aging Aircraft | 0 | 250 | 0 |
| (U) | Advanced Hybrid Propulsion Technologies Cooperative Research Project | 700 | 0 | 0 |
| (U) | ACES II - Ejection Seat Cooperative Modification Project | 1,000 | 0 | 0 |
| (U) | Air C3I Capabilities | 0 | 250 | 351 |
| (U) | CC3DE | 0 | 250 | 500 |
| (U) | ATLANTIC PAW | 0 | 250 | 850 |
| (U) | Observations and Modeling for Space Weather | 0 | 0 | 658 |
| (U) | Space Radiation Sensors | 0 | 100 | 200 |
| (U) | DMT Technologies | 0 | 250 | 500 |
| (U) | Refraction and Propagation Modeling for Microwave Systems | 0 | 0 | 200 |
| (U) | Engine Component Life Extension | 0 | 0 | 400 |
| (U) | Effects of Ionization on Hydrocarbon-Air Combustion | 0 | 0 | 400 |
| (U) | Scintillation Impacts on Communication and Navigation Systems | 0 | 300 | 300 |
| (U) | DMT and VAE Technologies | 0 | 0 | 250 |
| (U) | Flight Test Demonstration of Miniature Munitions Release from Internal Bay | 0 | 200 | 0 |
| (U) | Total | 3,956 | 4,222 | 5,509 |

Complete information regarding the use of NATO Cooperative R&D funds is not available for all proposed agreements, since some are still being negotiated or were

| RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3) | DATE February 2000 |
|---|---|
| BUDGET ACTIVITY<br>04 - Demonstration and Validation | PE NUMBER AND TITLE<br>0603790F NATO Cooperative R&D |
| PROJECT<br>64NATO | |

**(U) A. Project Cost Breakdown ($ in Thousands) Continued**

FY 1999 FY 2000 FY 2001

recently signed. In addition, information on the use of future funding for continuing agreeements is not available in all instances because the funds are used as needed to supplement a project office's related 6.1 through 6.5 RDT&E appropriations.

**(U) B. Budget Acquisition History and Planning Information ($ in Thousands)**

**(U) Performing Organizations:**

| Contractor or Government Performing Activity | Contract Method/Type or Funding Vehicle | Award or Obligation Date | Performing Activity EAC | Project Office EAC | Total Prior to FY 1999 | Budget FY 1999 | Budget FY 2000 | Budget FY 2001 | Budget to Complete | Total Program |
|---|---|---|---|---|---|---|---|---|---|---|
| Product Development Organizations | | | | | | | | | | |
| Lockheed Martin Colorado Springs, CO | CPAF | Oct 95 | | | 0 | 0 | 250 | 301 | | 551 |
| Sytronics Dayton, OH | CPFF | Apr 98 | | | 600 | 300 | 300 | 300 | | 1,500 |
| Boston College Boston, MA | CFSR | Mar 97 | | | 155 | 0 | 0 | 0 | | 155 |
| RADEX Bedford, MA | CPFF | Mar 97 | | | 385 | 75 | 55 | 50 | | 565 |
| Pacific Sierra Research Santa Monica, CA | CPFF | Mar 97 | | | 60 | 0 | 0 | 0 | | 60 |
| CPI Fairfax, VA | CPFF | Mar 97 | | | 160 | 20 | 20 | 20 | | 220 |
| U of Massachusetts Lowell, MA | CR | Apr 97 | | | 120 | 50 | 50 | 50 | | 270 |
| KEO Consultants Brookline, MA | CPFF | Mar 97 | | | 220 | 0 | 25 | 20 | | 265 |
| NW Research Associates Bellevue, WA | CPFF | Apr 97 | | | 80 | 0 | 50 | 50 | | 180 |
| U of Texas Austin, TX | CPFF | May 97 | | | 25 | 0 | 0 | 0 | | 25 |
| Applied Research Lab, U of Texas Austin, TX | CPFF | May 97 | | | 80 | 25 | 0 | 0 | | 105 |
| Lockheed Martin Orlando, FL | CPFF | Sep 96 | | | 913 | 535 | 0 | 0 | | 1,448 |
| Raytheon TI Systems | CPFF | Dec 97 | | | 683 | 0 | 0 | 0 | | 683 |

| RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3) | | | | | | | DATE: February 2000 |
|---|---|---|---|---|---|---|---|
| BUDGET ACTIVITY: 04 - Demonstration and Validation | | | PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D | | | | PROJECT: 64NATO |
| **(U) Performing Organizations Continued:** | | | | | | | |
| Product Development Organizations | | | | | | | |
| Boeing Seattle, WA | CPFF | Sep 98 | 260 | 200 | 500 | 360 | 1,320 |
| UES, Inc Dayton, OH | CPFF | Oct 97 | 100 | 100 | 0 | 0 | 200 |
| NOAA/ATDD Oak Ridge, TN | MIPR | Oct 97 | 0 | 80 | 0 | 0 | 80 |
| Pratt & Whitney West Palm Beach, FL | CPFF | Jun 98 | 1,000 | 0 | 334 | 0 | 1,334 |
| AFRL WPAFB, OH | TBD | TBD | 0 | 0 | 0 | 400 | 400 |
| Boeing Long Beach, CA | CPFF | Jul 98 | 265 | 0 | 0 | 0 | 265 |
| Boeing Seattle, WA | CPFF | Mar 98 | 200 | 0 | 0 | 0 | 200 |
| Lockheed Marietta, GA | CPFF | Oct 98 | 325 | 0 | 200 | 0 | 525 |
| Northrop Hawthorne, CA | CPFF | Oct 98 | 50 | 0 | 0 | 0 | 50 |
| Selectech Dayton, OH | CPFF | Feb 98 | 50 | 0 | 300 | 0 | 350 |
| Boeing St Louis, MO | CPFF | Mar 00 | 0 | 0 | 250 | 0 | 250 |
| University of South Carolina | CPFF | Apr 00 | 0 | 0 | 250 | 0 | 250 |
| Boeing St Louis, MO | CPIF | Apr 99 | 0 | 1,000 | 0 | 0 | 1,000 |
| Thiokol Corp Elkton, MD | CPFF | Nov 97 | 0 | 700 | 0 | 0 | 700 |
| Raytheon Mesa, AZ | CPFF | Jul 97 | 0 | 0 | 250 | 750 | 1,000 |
| CPI Annandale, VA | CPFF | TBD | 0 | 0 | 0 | 200 | 200 |
| U of Colorado Boulder, CO | CPFF | TBD | 0 | 0 | 0 | 100 | 100 |
| Boston College Newton, MA | CPFF | TBD | 0 | 0 | 0 | 50 | 50 |
| Radex | CPFF | Feb 01 | 0 | 0 | 0 | 150 | 150 |
| Applied Physics Lab Laurel, MD | MIPR | May 00 | 0 | 0 | 0 | 158 | 158 |
| Boston College Boston, MA | CPFF | TBD | 0 | 0 | 40 | 40 | 80 |
| Radex Bedford, MA | CPFF | TBD | 0 | 0 | 90 | 90 | 180 |
| U of Mass Lowell, MA | CR | TBD | 0 | 0 | 45 | 45 | 90 |
| Scion Associates Seattle, WA | CPFF | TBD | 0 | 0 | 60 | 65 | 125 |
| SRI, Int'l Menlo Park, CA | CPFF | TBD | 0 | 0 | 40 | 40 | 80 |
| AFRL Rome, NY | TBD | TBD | 0 | 0 | 500 | 1,350 | 1,850 |

| RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3) | | | | | | | | | DATE: February 2000 |
|---|---|---|---|---|---|---|---|---|---|
| BUDGET ACTIVITY: 04 - Demonstration and Validation | | | PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D | | | | | | PROJECT: 64NATO |

**(U) Performing Organizations Continued:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Product Development Organizations | | | | | | | |
| AFRL Hanscom, MA | TBD | TBD | 0 | 0 | 100 | 400 | 500 |
| Support and Management Organizations | | | | | | | |
| AFRL Hanscom, MA | | | 110 | 50 | 113 | 80 | 353 |
| AFRL WPAFB, OH | | | 5 | 0 | 20 | 400 | 425 |
| 45th Space Wing Patrick AFB, FL | AF 185 | May 95 | 5 | 0 | 0 | 0 | 5 |
| AFRL Eglin AFB, FL | | | 50 | 17 | 0 | 0 | 67 |
| Pender Technology, TN | CR | Oct 97 | 45 | 45 | 0 | 0 | 90 |
| Veridian Dayton, OH | | | 145 | 0 | 80 | 40 | 265 |
| Test and Evaluation Organizations | | | | | | | |
| Air Force Development Test Center, FL | PO | Jan 98 | 54 | 448 | 0 | 0 | 502 |
| Sverdrup Technology, Inc TN | CPAF | Sep 95 | 1,238 | 311 | 100 | 0 | 1,649 |
| Naval Air Warfare CenterPoint Mugu, CA | MIPR | Jan 99 | 40 | 0 | 0 | 0 | 40 |
| Arnold Engineering Development Center, TN | TBD | TBD | 0 | 0 | 200 | 0 | 200 |

*Not applicable. NATO Cooperative R&D funds supplement as needed a project office's 6.1 through 6.5 RDT&E appropriations for initiating international cooperative R&D agreements and exploiting favorable program and technological opportunities with major allied partners.

**(U) Government Furnished Property:**

| Item Description | Contract Method/Type or Funding Vehicle | Award or Obligation Date | Delivery Date | Total Prior to FY 1999 | Budget FY 1999 | Budget FY 2000 | Budget FY 2001 | Budget to Complete | Total Program |
|---|---|---|---|---|---|---|---|---|---|
| Product Development Property | | | | | | | | | |
| None | | | | | | | | | |
| Support and Management Property | | | | | | | | | |
| None | | | | | | | | | |

| RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3) | DATE: February 2000 |
|---|---|
| BUDGET ACTIVITY: 04 - Demonstration and Validation | PE NUMBER AND TITLE: 0603790F NATO Cooperative R&D |
| | PROJECT: 64NATO |

**(U) Government Furnished Property Continued:**

Test and Evaluation Property

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Fora laser system | PO | Nov 97 | Jan 98 | 147 | 0 | 0 | 0 | 0 | 147 |

| Subtotals | Total Prior to FY 1999 | Budget FY 1999 | Budget FY 2000 | Budget FY 2001 | Budget to Complete | Total Program |
|---|---|---|---|---|---|---|
| Subtotal Product Development | 5,731 | 3,085 | 3,709 | 4,989 | | 17,514 |
| Subtotal Support and Management | 360 | 112 | 213 | 520 | | 1,205 |
| Subtotal Test and Evaluation | 1,479 | 759 | 300 | 0 | 0 | 2,538 |
| Total Project | 7,570 | 3,956 | 4,222 | 5,509 | 0 | 21,257 |