

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 1999		
BUDGET ACTIVITY 4 - Demonstration and Validation				PE NUMBER AND TITLE 0603790F NATO Cooperative Research and Development					PROJECT NATO	
COST (\$ In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
NATO Nato Coop R&D	10,343	4,105	4,283	5,558	11,784	11,990	12,241	12,495	Continuing	Continuing
Quantity of RDT&E Articles	0	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 what Congress perceived as inadequate 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, and intelligence (C3I), 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.

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<p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <p align="center">(U) <u>Continuing Projects Initiated in FY95 and FY96 Under PE 0603790D:</u></p> <ul style="list-style-type: none"> <li>- (U) \$60 <b>Image Information Reformatter (IIR)</b> (Air Force Research Laboratory/France) - Cooperative project to define, develop and demonstrate an Advanced Development Model (ADM) - IIR for the purpose of demonstrating interoperability among allied tactical imagery reconnaissance collection and ground systems. In FY98 planning and coordination continued with the French for the cooperative Phase Two development of an ADM-IIR. The French program underwent significant financial and organizational reviews by the French Ministry of Defense. The US is planning to closely follow the French effort in order to maximize NATO interoperability initiatives and to emphasize extending the reformatting capability to address the US to NATO interface requirement.</li> <li>- (U) \$600 <b>Effects of the Ionosphere on Command, Control, Communications, and Intelligence (C3I) Systems</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to leverage complementary ionospheric sensors and data to develop capabilities for timely warning of ionospheric disturbances that disrupt C3I systems. In FY98 the project expanded the coverage area for which C3I system outage forecasts and alerts can be provided to include the South America and the Atlantic regions. In addition, the project initiated efforts to couple the sensor-driven Parameterized Ionosphere Specification Model (PRISM) to a United Kingdom analytic ray tracing code for radio wave propagation prediction applications; developed algorithms to couple Global Position System-Meteorological (GPS-Met) satellite data into PRISM; and began development of efficient techniques to fuse multiple sensor data and multiple battlespace environment models required for in-theater, real-time, specifications and forecasts of ionospheric and radio wave propagation conditions.</li> <li>- (U) \$150 <b>Single Mode Optical Fibers for Array Imaging and for Environmental Sensing</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to enhance the performance of single mode optical fibers for ultra-high angular resolution imaging in support of space surveillance needs. In FY98 the project completed acceptance tests on the multi-core single mode fibers (MCSMFs). Field test comparisons between the 4 cores Air Force prototype and the 3 and 6 core United Kingdom prototypes were also conducted. Drafted reports with analysis being prepared evaluating which prototype is the best in terms of cost, reliability, etc. MCSMFs offer the potential for transmitting light and images more efficiently.</li> <li>- (U) \$2,600 <b>Vista Warrior</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to develop and evaluate advanced helmet-mounted tracker and display (HMT/D) technologies, multi-sensory virtual interface concepts, and virtual display and control devices for incorporation into advanced aircraft. In FY98 the project demonstrated Helmet-Vehicle Interface (HVI) for binocular HMT/Ds; developed color image source technology for a monocular HMT/D for use in fast-jets for air-to-air and air-to-ground missions and evaluated the utility of color symbology; assessed technologies for a flight-worthy eye tracker for airborne eye pointing/targeting; completed development of global implicit situational awareness measurement system; and selected advanced, adaptive control and display concepts for simulator implementation, evaluation and later demonstration in aircraft.</li> </ul>		
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<p>(U) <u>Continuing Projects Initiated in FY97 Under PE 0603790F:</u></p> <ul style="list-style-type: none"> <li>– (U) \$1,500 <b>Dense Metal Case Penetrating Weapon (DMCPW)</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to develop and demonstrate technology for a dense metal penetrating warhead that is compatible with guidance kits such as PAVEWAY III and the Joint Deep Attack Munition (JDAM). This technology offers a two-fold increase in hard target defeat 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 subscale and full scale dynamic ground impact testing (sled and/or powder gun) with an option for flight demonstrations using PAVEWAY III guidance kits. In FY98 the project completed preliminary design of the DMCPW warhead and began scaling up the manufacturing processes. Other accomplishments in FY98 included completion of preliminary design of the US enhanced PAVEWAY III flight demonstration guidance kit and United Kingdom weaponization design studies.</li> <li>– (U) \$550 <b>Strengthening of Concrete Structures for Enhanced Structural Survivability Against Conventional and Terrorist Weapons</b> (Air Force Research Laboratory/Israel) - Cooperative project to develop rapid, inexpensive construction process to significantly increase the strength and resistance of existing or new conventional concrete and mason structures to terrorist vehicle bombs or tactical ballistic missile threats. Meets requirement to upgrade mission critical air base structures at both contingency and fixed bases, thereby reducing the need for new military construction. In FY98 the project evaluated and selected materials for further testing; test modules and components of structures under blast loading in the US and Israel; and conducted tests on complete structures in Israel. Systems validated on complete structures include masonry wall reinforcement with composite bonding, geotextile “catch” curtains, energy absorbing window frames, and sacrificial exterior panels. Report on data analysis completed to determine most effective methods for enforcing structural survivability.</li> <li>– (U) \$500 <b>Free Piston Shock Tunnel/High Enthalpy Goettingen Project</b> (Arnold Engineering and Development Center/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 Free Piston Shock Tunnel (FPST) and Germany’s High Enthalpy Goettingen (HEG) facilities. In FY98 FPST facility calibration and blunt cone tests were done in the US FPST. HEG supplied the data from their blunt cone tests and preliminary computational fluid dynamics (CFD) comparisons were accomplished. Two new non-intrusive diagnostics techniques were made operational in the FPST. US engineers visited the HEG facility, taking a variety of non-intrusive diagnostics systems, and gathered data during an HEG test program. The data will be used to further the development of US diagnostics capabilities.</li> <li>– (U) \$750 <b>Programmable Integrated Ordnance Suite (PIOS)</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to develop and demonstrate integrated missile ordnance technologies, including imaging infrared target detection devices (TDD), mass-focused or directional warheads, and advanced initiation fireset. The primary goal is to improve counter-air lethality against advanced fighter, bomber, helicopter, and cruise missile targets. Technical risk areas identified in FY97 were subjected to more detailed engineering analyses in FY98 to identify design approaches that mitigate risk. Initiated the preliminary design of an integrated counter air ordnance suite with support engineering rationale and lethality performance predictions.</li> </ul>		
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<p>(U) <u>Continuing Projects Initiated in FY97 Under PE 0603790D:</u></p> <ul style="list-style-type: none"> <li>- (U) \$1,150 <b>Regional/Sector Air Operations Center (R/SAOC) Modernization Program</b> (Electronic Systems Center/Canada) - Cooperative project to modernize existing R/SAOC computing and display capabilities to better support designated North American Aerospace Defense (NORAD) Command missions. In FY98 the project continued integrating R/SAOC with the Theater Battle Management Core System (TBMCS), Global Command and Control System (GCCS), and the Defense Information Infrastructure/Common Operating Environment (DII/COE).</li> <li>- (U) \$50 <b>Aftbody/NozzleAeroacoustics Project (ANAP)</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to develop jet screech frequency and amplitude prediction capabilities. Goal is to combine state-of-the-art US modeling techniques with unique United Kingdom anechoic chamber data to develop a tool which can be used for analysis and design tradeoffs. Nozzle screech has been shown to destroy exhaust structural components, and is particularly damaging in twin-jet configurations. In FY98, efforts focused on obtaining twin-jet screech data in the United Kingdom, and extended the analysis capabilities of the screech tool to twin-jet configurations. When complete, this will represent the only twin-jet predictive capability available (numerical or analytical).</li> </ul> <p>(U) <u>New Projects:</u></p> <ul style="list-style-type: none"> <li>- (U) \$283 <b>Cooperative Research and Development Efforts in Imaging Spectrometer Development</b> (Arnold Engineering and Development Center/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 FY98 the project surveyed available components and state-of-the-art technology for focal plane arrays, interferometers, and data acquisition hardware; began the preliminary design for a high-resolution sensor system; and identified long lead components.</li> <li>- (U) \$100 <b>Metal Matrix Composites for Aerospace Applications</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to improve the properties and processing of silicon carbide (SiC) - reinforced Titanium (Ti) - alloy and Aluminum (Al) - alloy metal matrix composites (MMCs) for aerospace applications. In FY98, the United Kingdom produced and supplied SiC fiber with three experimental coatings to the Air Force for evaluation. The strength and stiffness of the three coatings has been determined, and the adhesion of the coatings to the SiC fiber has been determined. High resolution transmission electron microscopy has provided detailed information of the structure of the coating, and this information is being used to establish the relationships between the structure and the properties of the coating. Initial samples with controlled fiber spacing have been prepared by the Air Force from matrix-coated SiC fibers for transverse mechanical characterization.</li> </ul>		
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– (U) \$450	<b>Integrated Tactical Aircraft Control (ITAC) Program</b> (Air Force Research Laboratory/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 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 FY98, the project initiated development of program documentation and technical definition to achieve a common understanding of system level requirements, tasks and major program deliverables. Established key agreements with other DoD organizations supporting out-year, cooperative US/French ITAC flight test activities.	
– (U) \$600	<b>Anthropometric Accommodation in Crew Systems</b> (Air Force Research Laboratory/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 data base with the assessment methods to assure accommodation and interoperability is achieved in the design process. In FY98 the project collected the first half of the 3-D data sets in the United States and initiated the aircraft measurements.	
– (U) \$400	<b>Aging Aircraft Life Prediction /Extension</b> (Air Force Research Laboratory/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 FY98 the project began documentation of experience with widespread fatigue damage and composite patch repairs, initiated analysis techniques for corrosion/fatigue, and began evaluating composite patch repair analysis techniques.	
– (U) \$350	<b>Structural Integrity of Aging Aircraft</b> (Air Force Research Laboratory/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 with fatigue, structural dynamics with emphasis on weapon bay acoustics, and structural health monitoring with emphasis on sensor development. In FY98 the project began documentation of experience with widespread fatigue damage and initiated evaluation of composite patch repair analysis techniques.	
– (U) \$250	<b>Airworthiness of Aging Aircraft</b> (Air Force Research Laboratory/United Kingdom) - 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 FY98 the project initiated documentation of experience with corrosion/fatigue and composite patch repairs, started development of analysis techniques for life enhancement, and began evaluation of composite patch repair analysis techniques.	
– (U) \$10,343	Total	
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<p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$139 Identified as a source for SBIR</li> </ul> <p>(U) <u>Continuing Projects Initiated in FY95 and FY96 under PE 0603790D:</u></p> <ul style="list-style-type: none"> <li>- (U) \$200 <b>Effects of the Ionosphere on Command, Control, Communications, and Intelligence (C3I) Systems</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to leverage complementary ionospheric sensors and data to develop capabilities for timely warning of ionospheric disturbances that disrupt C3I systems. In FY99 the project will expand the coverage area for which C3I system outage forecasts and alerts can be provided to include the North Africa/Middle East region and a ground-based, rapidly deployable, Space Weather Station will be assembled, employing multiple sensors and battlespace environment models to specify ionospheric and radio wave propagation conditions.</li> </ul> <p>(U) <u>Continuing Projects Initiated in FY97 under PE 0603790F:</u></p> <ul style="list-style-type: none"> <li>- (U) \$1,000 <b>Dense Metal Case Penetrating Weapon (DMCPW)</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to develop and demonstrate technology for a dense metal penetrating warhead, that is compatible with guidance kits such as PAVEWAY III and the Joint Deep Attack Munition (JDAM). This technology offers a two-fold increase in hard target defeat 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 subscale and full scale dynamic ground impact testing (sled and/or powder gun) with an option for flight demonstrations using PAVEWAY III guidance kits. In FY99 the project will complete the DMCPW warhead detailed design, development, and fabrication of full scale penetrators for the sled test program, which will be accomplished in FY00. In FY99 the enhanced PAVEWAY III guidance package will be flight tested using a MK-83 general purpose bomb equipped with a telemetry package.</li> <li>- (U) \$100 <b>Free Piston Shock Tunnel/High Enthalpy Goettingen Project</b> (Arnold Engineering and Development Center/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 Free Piston Shock Tunnel (FPST) and Germany's High Enthalpy Goettingen (HEG) facilities. In FY99 all testing will be completed in the FPST and the HEG; final computational fluid dynamics analysis of the data and CFD code development will be accomplished; and the final report will be prepared.</li> </ul>		
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<p>(U) <u>Continuing Projects Initiated in FY98 under PE 0603790D:</u></p> <ul style="list-style-type: none"> <li>- (U) \$703 <b>Advanced Hybrid Propulsion Technologies Cooperative Research Project</b> (Air Force Research Laboratory/Japan) - Cooperative project to develop hybrid propulsion technology for air-to-air missiles. In FY99 the project will develop 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.</li> <li>- (U) \$1,000 <b>Advanced Crew Ejection Seat (ACES) II - Ejection Seat Cooperative Modification Project</b> (Human Systems Center/Japan) - Cooperative project to develop and design a modification kit that can be retrofitted to the ACES II ejection seat to increase the safety and survivability of light weight aircrew members by: increasing the stability of the seat; increasing the seat/accommodation range; and adding limb restraints. ACES II ejection seat improvements include a gender free operational capability that assures equally reduced mortality rates and serious injuries for both male and female aircrew members. The successful 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. Work to be accomplished in FY99 will include the purchase of the remaining seats and hardware for the upcoming tests. The design stages will be complete and the qualification program will be initiated.</li> </ul> <p>(U) <u>Continuing Projects Initiated in FY98 under PE 0603790F:</u></p> <ul style="list-style-type: none"> <li>- (U) \$250 <b>Cooperative Research and Development Efforts in Imaging Spectrometer Development</b> (Arnold Engineering and Development Center/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 FY99 the project will investigate the data collection issues associated with imaging spectroscopy. Prototype data collection and analysis will be accomplished.</li> <li>- (U) \$100 <b>Metal Matrix Composites for Aerospace Applications</b> (Air Force Research Laboratory/United Kingdom) - 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 FY99, the relationships between the structure and properties of carbon coatings will be determined. Coating deposition parameters will be defined. Carbon coated SiC fibers will be produced by the United Kingdom and evaluated by the Air Force. Transverse testing of matrix-coated fibers will be completed and specification of matrix-coated fibers will be defined. A joint project to improve the mechanical properties of SiC-reinforced Al will be defined and initiated.</li> </ul>		
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<ul style="list-style-type: none"> <li>- (U) \$200    <b>Integrated Tactical Aircraft Control (ITAC) Program</b> (Air Force Research Laboratory/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 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 FY99 the project will complete system level definition and initiate detailed design. Core flight control algorithms, situation assessment methods, optimized flight management and health monitoring system architectures will be developed.</li> <li>- (U) \$300    <b>Anthropometric Accommodation in Crew Systems</b> (Air Force Research Laboratory/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 data base with the assessment methods to assure accommodation and interoperability is achieved in the design process. In FY99 the project will finish the United States 3-D data collection and the first half of the European and initiate the augmented reality assessment of the aircraft crewstations.</li> </ul> <p>(U) <u>New Projects:</u></p> <ul style="list-style-type: none"> <li>- (U) \$113    <b>Project Refractive Turbulence</b> (Air Force Research Laboratory/Australia) - Cooperative project to obtain accurate, statistically significant, world wide turbulence measurements. The turbulence data base is essential to support studies that evaluate atmospheric refraction propagation effects on the design/performance of the Airborne Laser (ABL). In FY99 the project will support data reduction and analyses of aircraft turbulence measurements in Korea/Japan area.</li> <li>- (U) \$4,105    Total</li> </ul>		
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<p>(U) <u>FY 2000 (\$ in Thousands):</u></p> <p style="padding-left: 40px;">(U) <u>Space:</u></p> <ul style="list-style-type: none"> <li>– (U) \$75 <b>Cooperative Space Measurements</b> (Air Force Research Laboratory/Germany) - Cooperative project to fly a Department of Defense developed space plasma detector aboard a German scientific spacecraft in 1999. Joint exchange and analysis of scientific data from this mission will be used to 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.</li> <li>– (U) \$200 <b>Observations and Modeling for Space Weather</b> (Air Force Research Laboratory/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 FY00 the project will begin improvements in the use of currently available sensor data to drive models of the space environment; launch the Ionospheric Occultation eXperiment (IOX); support on-orbit operations for and analyze data from IOX; and validate algorithms intended for future use with ultraviolet (UV) operational sensor data from the Defense Meteorological Satellite Program (DMSP).</li> <li>– (U) \$100 <b>Space Radiation Sensors</b> (Air Force Research Laboratory/United Kingdom) - 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 aboard a joint US/UK satellite mission. In FY00 the project will develop the preliminary space radiation data base using data from the US and UK instruments. Final verification of the US instrument's calibration will be performed using the preliminary data base.</li> </ul> <p style="padding-left: 40px;">(U) <u>Command, Control, Communications, Intelligence (C3I):</u></p> <ul style="list-style-type: none"> <li>– (U) \$538 <b>Image Information Reformatter (IIR)</b> (Air Force Research Laboratory/France) - Cooperative project to define, develop and demonstrate an Advanced Development Model (ADM) - IIR for the purpose of demonstrating interoperability among allied tactical imagery reconnaissance collection and ground systems. In FY00 the cooperative effort to develop the ADM-IIR will emphasize the reformatting functionality and interfacing with sensor and exploitation systems. US activities will emphasize how the reformatting technology can be implemented in a computer software configuration which is portable to existing US equipments and architectures.</li> <li>– (U) \$200 <b>Effects of the Ionosphere on Command, Control, Communications, and Intelligence (C3I) Systems</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to leverage complementary ionospheric sensors and data to develop capabilities for timely warning of ionospheric disturbances that disrupt C3I systems. In FY00 a ground-based Space Weather Station, employing multiple sensors and multiple battlespace environment models to specify ionospheric and radio wave propagation conditions, will be deployed and operated in the United Kingdom to demonstrate its potential for future, in-theater, support of operational C3I systems.</li> </ul>		
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– (U) \$150	<p><b>Solar Maximum Impacts on C3I Systems</b> (Air Force Research Laboratory/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 SouthEast Asia and the South Pacific where large ionospheric disturbances routinely occur. FY00 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.</p>	
– (U) \$250	<p><b>Air Command, Control, Communications and Intelligence Capabilities</b> (Electronic Systems Center/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&amp;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&amp;D into shared data environment, developing a concept of operation for the transfer of control between National and NATO C4I systems without interrupting combat operations; and the extension of a middleware/translator product needed for the successful prosecution of a combined/joint air operation.</p>	
– (U) \$250	<p><b>Coalition C3 Demonstration Environment (CC3DE)</b> (Air Force Research Laboratory/Australia, Canada, United Kingdom) - 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.</p>	
– (U) \$225	<p><b>Advanced Transmission Language and Allocation of New Technology for International Communication and Proliferation of Allied Waveforms (ATLANTIC PAW)</b> (Air Force Research Laboratory/France, Germany, United Kingdom) - Cooperative project to provide interoperability between newly fielded international radios and allow backward compatibility to existing radio systems. This will be accomplished by developing a common description language between participating countries which is interpretable by each nations programmable radio. This will allow new waveforms to be developed and integrated into each countries radio in an expedient and efficient manner. This methodology is synergistic with the current changing requirements of allied operations and communication. In FY00 the project will jointly create a description languagae which will be used to develop the definition parameters and their operation in communication assets.</p>	
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<p>(U) <u>Modernization:</u></p> <ul style="list-style-type: none"> <li>- (U) \$395 <b>Advanced Combustor Chamber Concepts Program</b> (Air Force Research Laboratory/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. Resulting engines will be simpler, easier to cool, lower weight, and more durable than baseline metallic designs.</li> <li>- (U) \$300 <b>Anthropometric Accommodation in Crew Systems</b> (Air Force Research Laboratory/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 data base with the assessment methods to assure accommodation and interoperability is achieved in the design process. In FY00 the project will finish the European data collection, the augmented reality assessment of the aircraft crewstations, and perform accommodation effect assessments using US and European data sets.</li> <li>- (U) \$600 <b>Integrated Tactical Aircraft Control (ITAC) Program</b> (Air Force Research Laboratory/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 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 FY00 the project will proceed with system mechanization and verification, hardware and software integration, and the development and testing of critical subsystems and test criteria.</li> </ul> <p>(U) <u>Readiness:</u></p> <ul style="list-style-type: none"> <li>- (U) \$400 <b>Aging Aircraft Life Prediction/Extension</b> (Air Force Research Laboratory/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 FY00 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 analysis techniques, and perform in-service evaluation of corrosion sensor.</li> </ul>		
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<b>4 - Demonstration and Validation</b>	<b>0603790F NATO Cooperative Research and Development</b>	<b>NATO</b>
<ul style="list-style-type: none"> <li>- (U) \$350 <b>Structural Integrity of Aging Aircraft</b> (Air Force Research Laboratory/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 with fatigue, structural dynamics with emphasis on weapon bay acoustics, and structural health monitoring with emphasis on sensor development. In FY00 the project will develop analytical models for widespread fatigue damage and corrosion/fatigue, complete evaluation of composite patch repair analysis techniques, and identify in-service dynamics problems.</li> <li>- (U) \$250 <b>Airworthiness of Aging Aircraft</b> (Air Force Research Laboratory/United Kingdom) - 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 FY00 the project will continue analysis techniques for corrosion/fatigue and continue developing analysis techniques for life enhancement and composite patch repairs.</li> <li>- (U) \$4,283 Total</li> </ul> <p>(U) <u>FY 2001 (\$ in Thousands):</u></p> <p style="padding-left: 40px;">(U) <u>Space:</u></p> <ul style="list-style-type: none"> <li>- (U) \$100 <b>Space Radiation Sensors</b> (Air Force Research Laboratory/United Kingdom) - 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 aboard a joint US/UK satellite mission. In FY01 the project will develop the final radiation data base.</li> <li>- (U) \$645 <b>Observations and Modeling for Space Weather</b> (Air Force Research Laboratory/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 space environment. In FY01 the project will continue work to improve the use of operational sensor data to drive models of the space environment; launch the experiment; support on-orbit operations and analysis from the experiment; prepare for the flight of the Auto-Calibrating Extreme ultraviolet Spectrometers (ACES) instrument which will provide calibrated solar flux measurements; modify models to accept solar inputs; and upgrade algorithms used with ultraviolet data from the Defense Meteorological Satellite Program (DMSP) satellite.</li> </ul>		
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<p>(U) <u>Command, Control, Communications, Intelligence (C3I)</u>:</p> <ul style="list-style-type: none"> <li>- (U) \$563 <b>Solar Maximum Impacts on C3I Systems</b> (Air Force Research Laboratory/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 SouthEast Asia and the South Pacific where large ionospheric disturbances routinely occur. In FY01 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, communication 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.</li> <li>- (U) \$350 <b>Air Command, Control, Communications and Intelligence Capabilities</b> (Electronic Systems Center/NATO Consultation, Command, and Control (C3) Agency) - Cooperative project to develop a fieldable interface between the US Contingency Theater Automated Planning System (CTAPS)/TBMCS and NATO Initial CAOC Capability (ICC) and the future NATO Air Command and Control System (ACCS). This cooperative R&amp;D effort will support air campaign planning and execution for joint and combined air operations. In FY01 work will focus on: 1. Productizing the C2 interface between the then 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 from one system to the other.</li> <li>- (U) \$750 <b>Advanced Transmission Language and Allocation of New Technology for International Communication and Proliferation of Allied Waveforms (ATLANTIC PAW)</b> (Air Force Research Laboratory/France, Germany, United Kingdom) - Cooperative project to provide interoperability between newly fielded international radios and allow backward compatibility to existing radio systems. This will be accomplished by developing a common description language between participating countries which is interpretable by each nations programmable radio. This will allow new waveforms to be developed and integrated into each countries radio in an expedient and efficient manner. This methodology is synergistic with the current changing requirements of allied operations and communication. In FY01 the project will continue creating a description languagae which will be used to develop the definition parameters and their operation in communication assets.</li> <li>- (U) \$500 <b>Coalition C3 Demonstration Environment (CC3DE)</b> (Air Force Research Laboratory/Australia, Canada, United Kingdom) - 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.</li> <li>- (U) \$1,350 <b>Image Information Reformatter (IIR)</b> (Air Force Research Laboratory/France) - Cooperative project to define, develop and demonstrate an Advanced Development Model (ADM) - IIR for the purpose of demonstrating interoperability among allied tactical imagery reconnaissance collection and ground systems.</li> </ul>		
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<p>(U) <u>Modernization:</u></p> <ul style="list-style-type: none"> <li>- (U) \$200 <b>Refraction and Propagation Modeling for Microwave Systems</b> (Air Force Research Laboratory/Australia, United Kingdom) - Cooperative project to develop a methodology for evaluating refraction conditions expected to result in adverse performance of microwave systems by coupling airborne refraction measurements with parabolic equation methods of microwave propagation modeling.</li> <li>- (U) \$400 <b>Effects of Ionization on Hydrocarbon Combustion</b> (Air Force Research Laboratory/United Kingdom) - 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.</li> </ul> <p>(U) <u>Readiness:</u></p> <ul style="list-style-type: none"> <li>- (U) \$200 <b>Engine Life Component Extension</b> (Air Force Research Laboratory/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.</li> <li>- (U) \$500 <b>Distributed Mission Training (DMT) Technologies</b> (Air Force Research Laboratory/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 constructive simulations allowing warfighters to train individually or collectively at all levels of war.</li> <li>- (U) \$5,558 Total</li> </ul> <p>(U) <b>B. <u>Budget Activity Justification</u></b></p> <p>This PE is designated in Budget Activity 4 because most of the ICRD&amp;A projects support specific systems, include all efforts necessary to evaluate integrated technologies in as realistic an operating environment as possible to assess the performance or cost reduction potential of advanced technology and help expedite technology transition from the laboratory to operational use.</p>		
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<b>(U) C. <u>Program Change Summary (\$ in Thousands)</u></b>										
	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>Total Cost</u>					
(U) Previous President's Budget FY 1999 PB	10,414	11,117	11,291	11,913						
(U) Appropriated Value	11,000	4,117								
(U) Adjustments to Appropriated Value										
a. Cong Reductions	-381	-12								
b. SBIR	-206									
c. Omnibus or Other Above Threshold Reprogram	-70									
d. Below Threshold Reprogramming										
(U) Adjustments to Budget Years Since FY 1999 PB			-7,008	-6,355						
(U) Current Budget Submit/FY 2000 PB	10,343	4,105	4,283	5,558						
 (U) Significant Program Changes:										
FY 1999: \$139 identified as a source for SBIR.										
Change Summary Explanation: Realignment of FY00 and FY01 funds from NATO R&D PE into PEs supporting the cooperative project.										
 <b>(U) D. <u>Other Program Funding Summary (\$ in Thousands)</u></b>										
	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>	<u>To Compl</u>	<u>Total Cost</u>
(U) N/A										
Related RDT&E:										
(U) This program element complements OSD NATO Cooperative R&D PE 0603790D which funds the first year only of any new DoD agreement. It also 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.										
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<b>(U) E. Acquisition Strategy:</b>																
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.																
<b>(U) F. Schedule Profile</b>																
		<u>FY 1998</u>				<u>FY 1999</u>				<u>FY 2000</u>				<u>FY 2001</u>		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>(U) Image/Information Reformatter (IIR)</b>																
(U) Concept definition activities	*			*												
(U) Request for proposal released									X							
(U) Contract award														X		
(U) Development and fabrication of Advanced Development Model IIR and interfaces														X		X
<b>(U) Vista Warrior</b>																
(U) Develop and demonstrate advanced technologies and interface concepts in labs and simulators								X								
(U) Demonstrate the technology developed on operational fast jet aircraft	*								X							
(U) Assess advanced head/helmet tracker technologies	*			*												
(U) Demonstrate advanced head/helmet tracker					X	X										
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	<u>FY 1998</u>				<u>FY 1999</u>				<u>FY 2000</u>				<u>FY 2001</u>			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>(U) Effects of the Ionosphere on C3I Systems</b>																
(U) UK provide the latest Ray-Tracing algorithms for use with the US Parameterized Ionosphere-Specification Model (PRISM)		*														
(U) Assess UK oblique sounder system		*														
(U) Expand C3I outage alert areas to include South American and Atlantic sectors		*														
(U) Couple ray- trace/ionospheric model					X											
(U) Assemble ground-based Space Weather Station (SWS)							X									
(U) Expand C3I outage alert coverage to include North Africa/Middle East sector								X								
(U) Deploy SWS to United Kingdom									X							
(U) Demonstrate use of SWS to support C3I systems operations												X				
<b>(U) Dense Metal Case Penetrating Weapon (DMCPW)</b>																
(U) Preliminary design						X										
(U) Detailed design, development, and ground testing						X				X						
(U) Final design and flight testing										X				X		
(U) US ground sled demonstration tests									X	X						
(U) US flight weapon demonstration tests															X	
(U) UK subscale full scale penetrator design and underground trials								X								
(U) System analyses and material tests															X	
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	<u>FY 1998</u>				<u>FY 1999</u>				<u>FY 2000</u>				<u>FY 2001</u>			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>(U) Cooperative Research and Development Efforts in Imaging Spectrometer Development</b>																
(U) Agreement signed				*												
(U) Preliminary design							X									
(U) Concept checkout								X								
(U) Interim report														X		
(U) Advanced design														X		
<b>(U) Free Piston Shock Tunnel/High Enthalpy Goettingen Project</b>																
(U) Calibration, fabrication of models, testing		*					X									
(U) Exchange consultations		*														
(U) Exchange instrumentation and diagnostic articles		*	*			X	X									
(U) Computational fluid dynamics code development and validation		*					X									
(U) Final report												X				
<b>(U) Programmable Integrated Ordnance Suite (PIOS)</b>																
(U) Model and evaluate concept ordnance suites		*														
(U) Perform preliminary design of selected ordnance suite concept		*		*												
(U) Perform detailed engineering design of fuze and warhead						X				X						
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	<u>FY 1998</u>				<u>FY 1999</u>				<u>FY 2000</u>				<u>FY 2001</u>			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>(U) Observations and Modeling for Space Weather</b>																
(U) Agreement signed									X							
(U) Exchange existing data									X							
(U) Analyze existing data										X			X			
(U) Test and upgrade models									X							X
(U) Prepare/launch satellite experiments									X	X				X	X	
(U) Support on-orbit operations									X							X
(U) Analysis of satellite data										X						X
<b>(U) Regional/Sector Air Operations Center (R/SAOC) Modernization Program</b>																
(U) Hardware & software procurement			*													
(U) Procure operator work stations				*												
(U) US Site 1 turned over											X					
(U) Canada Site 2 turned over								X					X			
(U) US Site 3 turned over														X		
(U) US Site 4 turned over															X	
(U) US Site 5 turned over																X
<b>(U) Strengthening of Concrete Structures for Enhanced Structural Survivability Against Conventional and Terrorist Weapons</b>																
(U) Materials evaluation and selection	*															
(U) Structural component evaluation		*														
(U) Full structure field tests	*			*												
(U) Data reduction/analysis/field manual				*			X									

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	<u>FY 1998</u>				<u>FY 1999</u>				<u>FY 2000</u>				<u>FY 2001</u>			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>(U) Cooperative Space Measurements</b>																
(U) Preliminary design	*															
(U) Detailed design	*		*													
(U) Development and test	*					X										
(U) Agreement signed						X										
(U) Delivery to spacecraft integrator						X										
(U) Spacecraft integration and test						X			X							
(U) Launch									X							
(U) Data collection									X							X
<b>(U) Project Refractive Turbulence</b>																
(U) Design probe supports	*															
(U) Build tail probe mounts			*													
(U) Install tail turbulence probes				*												
(U) Aircraft certification				*												
(U) Agreement signed						X										
(U) Test measuring systems on aircraft		*		*												
(U) Flight measurements				*		X		X								
(U) Field measurement reports				*	X	X		X								X
(U) Data reduction				*		X		X								
(U) Data analysis				*												X
<b>(U) Single Mode (SM) Optical Fibers for Array Imaging and for Environmental Sensing</b>																
(U) Test and evaluation of Multi-Core SM Fiber (MCSMF)	*			*												
(U) Construction of fiber sensor and prototype					X			X								

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		<u>FY 1998</u>				<u>FY 1999</u>				<u>FY 2000</u>				<u>FY 2001</u>			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>(U) Metal Matrix Composites (MMCs) for Aerospace Applications</b>																	
(U) Agreement signed	*																
(U) Concept definition	*						X										
(U) Produce and evaluate MMCs	*								X								
(U) Specify improved MMCs						X			X								
(U) Produce and evaluate improved MMC										X							
<b>(U) Advanced Combustor Chamber Concepts Program</b>																	
(U) Agreement signed	*																
(U) Material/fabrication sample tests	*				*												
(U) Combustor cooled panel design and fabrication	*							X									
(U) Cooled panel tests								X			X						
(U) Combustor chamber design and fabrication									X						X		
(U) Combustor chamber tests																X	
<b>(U) Integrated Tactical Aircraft Control (ITAC) Program</b>																	
(U) Agreement signed	*																
(U) System definition					*	X											
(U) System design						X			X								
(U) Detailed design									X			X					
(U) System mechanization											X		X				X

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	<u>FY 1998</u>				<u>FY 1999</u>				<u>FY 2000</u>				<u>FY 2001</u>			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>(U) Anthropometric Accommodation in Crew Systems</b>																
(U) Agreement signed				*												
(U) Conduct anthropometric survey				*							X					
(U) Assess subjects in actual cockpits					X	X										
(U) Assess one model in the US and one model in The Netherlands							X	X								
(U) Augmented reality assessments								X			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				
<b>(U) Aftbody/Nozzle Aeroacoustics Program (ANAP)</b>																
(U) US modeling and analysis activities					X	X										
(U) United Kingdom single jet hot/cold data	*															
(U) US/United Kingdom planning and data reduction	*			*		X										
(U) United Kingdom twin jet hot/cold data				*												
(U) Application of screech tool to target twin-jet fighter application				*	X											

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					<u>FY 1998</u>		<u>FY 1999</u>		<u>FY 2000</u>		<u>FY 2001</u>					
					1	2	3	4	1	2	3	4	1	2	3	4
<b>(U) Structural Integrity of Aging Aircraft</b>																
(U) Agreement signed					*											
(U) Document widespread fatigue damage service experience								*								
(U) Develop widespread fatigue damage analytical models												X				
(U) Develop corrosion/fatigue analysis techniques									X							
(U) Evaluate existing composite patch analysis techniques for metallic structures															*	
(U) Identify candidate solutions for dynamic control												X				
(U) Develop health monitoring brassboard models										X						
(U) Identify fatigue life enhancement techniques												X				
<b>(U) Airworthiness of Aging Aircraft</b>																
(U) Agreement signed					*											
(U) Develop life enhancement analysis techniques										X						
(U) Conduct experiments												X				
(U) Document corrosion/fatigue service experience															*	
(U) Document composite patch service experience							*									
(U) Evaluate existing composite patch analysis techniques for metallic structures														*		

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	1	<u>FY 1998</u>			1	<u>FY 1999</u>			1	<u>FY 2000</u>			1	<u>FY 2001</u>		
		2	3	4		2	3	4		2	3	4		2	3	4
<b>(U) Aging Aircraft Life Prediction/ Extension</b>																
(U) Agreement signed		*														
(U) Document widespread fatigue damage			*													
(U) Coordinate with US							X									
(U) Develop corrosion/fatigue analysis techniques				*												
(U) Document composite patch service experience		*														
(U) Evaluate existinng composite patch analysis techniques for metallic structures		*														
(U) Identify health monitoring sensors		*														
(U) Prepare for flight tests				*												
<b>(U) Advanced Hybrid Propulsion Technologies Cooperative Research Project</b>																
(U) Agreement signed			*													
(U) Detail design	*															
(U) Oxidizer expulsion system	*						X									
(U) Controls	*	*			X		X									
(U) Injector		*				X	X									
(U) Pressurization system	*						X									
(U) Oxidizer development	*							X								
(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	X	

Project NATO

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)												DATE February 1999		
BUDGET ACTIVITY <b>4 - Demonstration and Validation</b>						PE NUMBER AND TITLE <b>0603790F NATO Cooperative Research and Development</b>						PROJECT <b>NATO</b>		
		<u>FY 1998</u>			<u>FY 1999</u>			<u>FY 2000</u>			<u>FY 2001</u>			
		1	2	3	4	1	2	3	4	1	2	3	4	
<b>(U) Advanced Crew Ejection Seat (ACES) II - Ejection Seat Cooperative Modification Project</b>														
(U) ACES II Preliminary design			*											
(U) Agreement signed			*											
(U) Engineering, manufacturing, development					*									
(U) Detailed design						X								
(U) Complete design								X						
(U) Qualification program									X					
<b>(U) Space Radiation Sensors</b>														
(U) Agreement signed								X						
(U) Calibration review								X		X				
(U) Preliminary data base									X			X		
(U) Verification of calibration												X		
(U)Final unified data base												X		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)											DATE February 1999							
BUDGET ACTIVITY <b>4 - Demonstration and Validation</b>					PE NUMBER AND TITLE <b>0603790F NATO Cooperative Research and Development</b>							PROJECT <b>NATO</b>						
					<u>FY 1998</u>		<u>FY 1999</u>		<u>FY 2000</u>		<u>FY 2001</u>							
					1	2	3	4	1	2	3	4	1	2	3	4		
<b>(U) Air Command, Control, Communications and Intelligence Capabilities</b>																		
(U) Agreement Signed																		
(U) Draft program and implementation plan																		
(U) Contract change request released								*										
(U) Issue technical task descriptive																		
(U) Program definition																		
(U) Scope work effort to achieve shared data environment																		
(U) Develop translator extensions																		
(U) US/NATO Battle Lab verification and development test																		
(U) Examine US/NATO Concept of Operations in coalition environment in terms of shared data environment																		
<b>(U) Coalition C3 Demonstration Environment (CC3DE)</b>																		
(U) Agreement Signed																		
(U) Testbed Setup & Evaluation																		
(U) Network management integration																		
(U) C3I application and integration demonstrations																		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)												DATE February 1999					
BUDGET ACTIVITY <b>4 - Demonstration and Validation</b>					PE NUMBER AND TITLE <b>0603790F NATO Cooperative Research and Development</b>							PROJECT <b>NATO</b>					
					<u>FY 1998</u>		<u>FY 1999</u>		<u>FY 2000</u>		<u>FY 2001</u>						
					1	2	3	4	1	2	3	4	1	2	3	4	
<b>(U) Advanced Transmission Language and Allocation of New Technology for International Communication and Proliferation of Allied Waveforms (ATLANTIC PAW)</b>																	
(U) Radio development																	
(U) Compliance testing (Germany)																	
(U) Compliance testing (United Kingdom)																	
(U) Agreement signed																	
(U) Initial meeting																	
(U) Tool characterization																	
(U) Interpreter characterization																	
(U) Allied waveform coding																	
 <b>(U) Solar Maximum Impacts on C3I Systems</b>																	
(U) Agreement Signed																	
(U) Implement real-time data collection at existing sites																	
(U) Deploy scintillation monitors																	
(U) Correlate and calibrate data sets																	
(U) Characterize local disturbance climatology																	
(U) Campaign/complete data collection																	
(U) Develop regional forecast algorithms																	
(U) Report on regional scintillation and tailored products for C3I systems support																	

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE		
BUDGET ACTIVITY <b>4 - Demonstration and Validation</b>		February 1999		
PE NUMBER AND TITLE <b>0603790F NATO Cooperative Research and Development</b>		PROJECT <b>NATO</b>		
<b>(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u></b>				
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 recently signed. In addition, future funding for continuing agreements 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>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>
(U) Image Information Reformatter (IIR)	60	0	538	1,350
(U) Vista Warrior	2,600	0	0	0
(U) Effects of the Ionosphere on Command, Control, Communications, and Intelligence (C3I) Systems	600	200	200	0
(U) Single Mode Optical Fibers for Array Imaging and for Environmental Sensing	150	0	0	0
(U) Strengthening of Concrete Structures for Enhanced Structural Survivability Against Conventional and Terrorist Weapons	550	0	0	0
(U) Free Piston Shock Tunnel/High Enthalpy Goettingen Project	500	100	0	0
(U) Programmable Integrated Ordnance Suite (PIOS)	750	0	0	0
(U) Dense Metal Case Penetrating Weapon (DMCPW)	1,500	1,000	0	0
(U) Aftbody/Nozzle Aeroacoustics Program (ANAP)	50	0	0	0
(U) Regional/Sector Air Operations Center (R/SAOC) Modernization Program	1,150	0	0	0
(U) Cooperative Research and Development Efforts in Imaging Spectrometer Development	283	250	0	0
(U) Metal Matrix Composites for Aerospace Applications	100	100	0	0
(U) Cooperative Space Measurements	0	0	75	0
(U) Project Refractive Turbulence	0	113	0	0
(U) Advanced Combustor Chamber Concepts Program	0	0	395	0
(U) Integrated Tactical Aircraft Control (ITAC) Program	450	200	600	0
Project NATO				

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<b>RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)</b>				DATE <b>February 1999</b>
BUDGET ACTIVITY	PE NUMBER AND TITLE			PROJECT
<b>4 - Demonstration and Validation</b>	<b>0603790F NATO Cooperative Research and Development</b>			<b>NATO</b>
	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>
(U) Anthropometric Accommodation in Crew Systems	600	300	300	0
(U) Aging Aircraft Life Prediction/Extension	400	0	400	0
(U) Structural Integrity of Aging Aircraft	350	0	350	0
(U) Airworthiness of Aging Aircraft	250	0	250	0
(U) Advanced Hybrid Propulsion Technologies Cooperative Research Project	0	703	0	0
(U) Advanced Crew Ejection Seat (ACES) II - Ejection Seat Cooperative Modification Project	0	1000	0	0
(U) Air Command, Control, Communications and Intelligence Capabilities	0	0	250	350
(U) A Coalition Command, Control and Communications Demonstration Environment (CC3DE)	0	0	250	500
(U) Advanced Transmission Language and Allocation of New Technology for International Communications and Proliferation of Allied Waveforms (ATLANTIC PAW)	0	0	225	750
(U) Observations and Modeling for Space Weather	0	0	200	645
(U) Solar Maximum Impacts on C3I Systems	0	0	150	563
(U) Space Radiation Sensors	0	0	100	100
(U) Distributed Mission Training (DMT) Technologies	0	0	0	500
(U) Refraction and Propagation Modeling for Microwave Systems	0	0	0	200
(U) Engine Component Life Extension	0	0	0	200
(U) Effects of Ionization on Hydrocarbon-Air Combustion	0	0	0	400
(U) Identified as a source for SBIR	0	139	0	0
(U) Total	10,343	4,105	4,283	5,558

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE February 1999	
BUDGET ACTIVITY 4 - Demonstration and Validation					PE NUMBER AND TITLE 0603790F NATO Cooperative Research and Development					PROJECT NATO	
<b>(U) B. <u>Budget Acquisition History and Planning Information (\$ in Thousands)</u></b>											
<b>Performing Organizations:</b>											
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 1998	Budget FY 1998	Budget FY 1999	Budget FY 2000	Budget FY 2001	Budget to Complete	Total Program
Identified as a source for SBIR					0	0	139	0	0	0	139
<u>Product Development Organizations</u>											
L3 Communications Salt Lake City, UT	CPFF	Sep 95			101	0	0	0	0	0	101
TBD Lockheed Martin Colorado Springs, CO	CPFF	TBD			0	0	0	538	1,350	0	1,888
Lockheed Martin Colorado Springs, CO	CPAF	Oct 95			1,078	0	0	250	350	TBD	TBD
AEM Inc. Denver, CO	FFFP	Jul 98			25	0	0	0	0	0	25
DRC Andover, MA	FFFP	Aug 98			19	0	0	0	0	0	19
KKP Corporation Nashua, NH	FFFP	Aug 98			129	0	0	0	0	0	129
Gateway Souix Falls, SD	FFFP	Aug 98			30	0	0	0	0	0	30
Project NATO											

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	
BUDGET ACTIVITY										February 1999	
4 - Demonstration and Validation					PE NUMBER AND TITLE					PROJECT	
					0603790F NATO Cooperative Research and Development					NATO	
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 1998	Budget FY 1998	Budget FY 1999	Budget FY 2000	Budget FY 2001	Budget to Complete	Total Program
Logicon San Pedro, CA	CPFF	Jun 94			1,000	0	0	0	0	0	1,000
Boeing St Louis, MO	CPIF	May 94			1,450	900	0	0	0	0	2,350
Sytronics Dayton, OH	CPFF	Sep 93			2	600	300	300	0	0	1,202
Logicon San Pedro, CA	CPFF	Jan 94			1,246	1,060	0	0	0	0	2,306
Night Vision Corporation Lincolnwood, IL	CPFF	Jul 96			0	500	0	0	0	0	500
Boston College Boston, MA	CFSR	Mar 97			50	105	0	0	0	0	155
RADEX Bedford, MA	CPFF	Mar 97			190	195	100	100	0	0	585
Pacific Sierra Research Santa Monica, CA	CPFF	Mar 97			60	0	0	0	0	0	60
CPI Fairfax, VA	CPFF	Mar 97			75	85	0	0	0	0	160
University of Massachusetts Lowell, MA	CR	Apr 97			60	60	20	30	50	0	220
KEO Consultants Brookline, MA	CPFF	Mar 97			160	60	20	50	85	0	375
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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE February 1999	
BUDGET ACTIVITY <b>4 - Demonstration and Validation</b>					PE NUMBER AND TITLE <b>0603790F NATO Cooperative Research and Development</b>					PROJECT <b>NATO</b>	
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 1998	Budget FY 1998	Budget FY 1999	Budget FY 2000	Budget FY 2001	Budget to Complete	Total Program
Northwest Research Associates Bellevue, WA	CPFF	Apr 97			50	30	50	50	30	0	210
University of Texas Austin, TX	CPFF	May 97			25	0	0	0	0	0	25
Applied Research Lab, University of Texas Austin, TX	CPFF	May 97			40	40	0	0	0	0	80
Boston College Boston, MA	CPFF	Mar 99			0	0	0	0	40	0	40
RADEX Bedford, MA	CPFF	Feb 99			0	0	0	55	150	0	205
Scion Assoc Seattle, WA	CPFF	Aug 99			0	0	0	30	85	0	115
SRI, Intl Menlo Park, CA	CPFF	Aug 99			0	0	0	10	80	0	90
Rome Research Corporation Rome, NY	CPFF	Oct 96			600	0	0	0	0	0	600
Motorola Scottsdale, AZ	CPFF	Aug 96			287	750	0	0	0	0	1,037
Lockheed Martin Orlando, FL	CPFF	Sep 96			150	450	442	0	0	0	1,042
Project NATO											

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	
BUDGET ACTIVITY										February 1999	
4 - Demonstration and Validation					PE NUMBER AND TITLE					PROJECT	
					0603790F NATO Cooperative Research and Development					NATO	
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 1998	Budget FY 1998	Budget FY 1999	Budget FY 2000	Budget FY 2001	Budget to Complete	Total Program
Raytheon TI Systems Lewisville, TX	CPFF	Dec 97			50	900	200	0	0	0	1,150
Waterways Experiment Station (WES) Vicksburg, MS	MIPR	Jul 97			175	225	0	0	0	0	400
Applied Research Associates Panama City, FL	CPAF	Aug 97			175	225	0	0	0	0	400
Active Control Experts, Inc Cambridge, MA	CPFF	Sep 97			200	0	0	0	0	0	200
Litton Data Systems Division, Agoura Hills, CA	CPAF	Mar 97			0	1,150	0	0	0	0	1,150
Boeing Seattle, WA	CPFF	Jul 98			0	260	115	540	0	0	915
UES, Inc Dayton, OH	CPFF	Oct 97			0	100	100	0	0	0	200
NOAA/ATDD Oak Ridge, TN	MIPR	Oct 97			0	0	58	0	0	0	58
Amptek, Inc Bedford, MA	CPFF	Aug 96			0	0	0	75	0	0	75
Project NATO					Page 33 of 39 Pages			Exhibit R-3 (PE 0603790F)			

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BUDGET ACTIVITY  
**4 - Demonstration and Validation**

PE NUMBER AND TITLE  
**0603790F NATO Cooperative Research and Development**

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 1998	Budget FY 1998	Budget FY 1999	Budget FY 2000	Budget FY 2001	Budget to Complete	Total Program
CPI Annandale, VA	CPFF	Feb 00			0	0	0	75	150	TBD	TBD
RADEX Bedford, MA	CPFF	Feb 00			0	0	0	75	120	TBD	TBD
University of Colorado Boulder, CO	CPFF	Feb 01			0	0	0	0	150	TBD	TBD
Boston College Newton, MA	CPFF	Mar 01			0	0	0	0	50	TBD	TBD
Aerospace Corp Los Angeles, CA	CPFF	Mar 00			0	0	0	50	75	TBD	TBD
Applied Physics Lab Laurel, MD	MIPR	May 00			0	0	0	0	100	TBD	TBD
Pratt & Whitney West Palm Beach, FL	CPFF	Jun 98			0	0	0	395	0	0	395
Boeing Long Beach, CA	CPFF	Jul 98			0	265	0	0	0	0	265
Boeing Seattle, WA	CPFF	Mar 98			0	200	0	0	0	0	200
Lockheed Marietta, GA	CPFF	Oct 98			0	325	0	200	0	0	525
Northrop Hawthorne, CA	CPFF	Oct 98			0	50	0	0	0	0	50
Selectech Dayton, OH	CPFF	Feb 98			0	50	0	300	0	0	350

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<b>RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)</b>										DATE <b>February 1999</b>	
BUDGET ACTIVITY <b>4 - Demonstration and Validation</b>					PE NUMBER AND TITLE <b>0603790F NATO Cooperative Research and Development</b>					PROJECT <b>NATO</b>	
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 1998	Budget FY 1998	Budget FY 1999	Budget FY 2000	Budget FY 2001	Budget to Complete	Total Program
Boeing St Louis, MO	CPFF	TBD			0	0	0	250	0	0	250
TBD	TBD	TBD			0	0	0	250	0	0	250
Boeing (McDonnell Douglas) St Louis, MO	CPFF	Oct 98			0	0	900	0	0	0	900
Boeing (McDonnell Douglas) St Louis, MO	CPFF	Dec 96			0	50	0	0	0	0	50
Thiokol Corp Elkton, MD	CPFF	Nov 97			0	0	703	0	0	0	703
Raytheon Mesa, AZ	CPFF	Jul 97			0	0	0	0	500	500	1,000
Air Force Research Laboratory Rome, NY					0	0	0	475	1,250	TBD	TBD
<u>Support and Management Organizations</u>											
Air Force Research Laboratory Rome, NY					189	60	0	0	0	0	249
Air Force Research Laboratory Rome, NY	AF 616	Jan 96			80	0	0	0	0	0	80
Project NATO											

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE February 1999	
BUDGET ACTIVITY <b>4 - Demonstration and Validation</b>					PE NUMBER AND TITLE <b>0603790F NATO Cooperative Research and Development</b>					PROJECT <b>NATO</b>	
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 1998	Budget FY 1998	Budget FY 1999	Budget FY 2000	Budget FY 2001	Budget to Complete	Total Program
MITRE	MIPR	Jan 96			300	0	0	0	0	0	300
Bedford, MA											
Electronic Systems Center, Hanscom AFB, MA					324	0	0	0	0	0	324
Air Force Research Laboratory WPAFB, OH					44	70	0	0	0	0	114
Air Force Research Laboratory Hanscom AFB, MA					85	25	10	125	543	TBD	TBD
45 <sup>th</sup> Space Wing Patrick AFB, FL	AF 185	May 95			5	0	0	0	0	0	5
BMDO Rockwell Power Systems, NM	MIPR				50	50	0	0	0	0	100
Air Force Research Laboratory Kirtland AFB, NM	CPAF				70	70	0	0	0	0	140
Air Force Research Laboratory Kirtland AFB, NM					30	30	0	0	0	0	60

Project NATO

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE February 1999	
BUDGET ACTIVITY <b>4 - Demonstration and Validation</b>					PE NUMBER AND TITLE <b>0603790F NATO Cooperative Research and Development</b>					PROJECT <b>NATO</b>	
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 1998	Budget FY 1998	Budget FY 1999	Budget FY 2000	Budget FY 2001	Budget to Complete	Total Program
Air Force Research Laboratory Hanscom AFB, MA					0	0	25	0	0	0	25
Worcester Polytech Institute Worcester, MA	IPA	Oct 97			0	0	30	0	0	0	30
Air Force Research Laboratory Eglin AFB, FL					308	60	58	0	0	0	426
Naval Air Warfare Center, CA	MIPR	May 97			115	0	0	0	0	0	115
Dynetics Fort Walton, FL	AFMC 277	Jun 97			40	0	0	0	0	0	40
Air Force Research Laboratory Tyndall AFB, FL					25	25	0	0	0	0	50
Pender Technology, TN	CR	Oct 97			0	50	50	0	0	0	100
Human Systems Center Brooks AFB, TX	MIPR	Oct 98			0	0	100	0	0	0	100
Project NATO											

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE February 1999	
BUDGET ACTIVITY <b>4 - Demonstration and Validation</b>					PE NUMBER AND TITLE <b>0603790F NATO Cooperative Research and Development</b>					PROJECT <b>NATO</b>	
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 1998	Budget FY 1998	Budget FY 1999	Budget FY 2000	Budget FY 2001	Budget to Complete	Total Program
Air Force Research Laboratory WPAFB, OH					0	65	28	20	400	TBD	TBD
Veridian Dayton, OH					0	145	0	0	0	0	145
Antion Corp. Dayton, OH	CPFF	Dec 98			0	50	0	0	0	0	50
<u>Test and Evaluation Organizations</u>											
Air Force Research Laboratory Rome, NY	MIPR	Jan 97			100	0	0	0	0	0	100
Air Force Development Test Center, FL	PO	Jan 98			0	80	288	0	0	0	368
Air Force Seek Eagle Office, FL	PO	Jan 98			0	10	12	0	0	0	22
Air Force Research Laboratory Tyndall AFB, FL					75	75	0	0	0	0	150
Sverdrup Technology, Inc TN	CPAF	Sep 95			353	733	300	0	0	0	1,386
Project NATO											

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**February 1999**

BUDGET ACTIVITY  
**4 - Demonstration and Validation**

PE NUMBER AND TITLE  
**0603790F NATO Cooperative Research and Development**

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 1998	Budget FY 1998	Budget FY 1999	Budget FY 2000	Budget FY 2001	Budget to Complete	Total Program
Naval Air Warfare Center Point Mugu, CA	MIPR				0	40	57	40	0	0	137

\*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.

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)								DATE February 1999		
BUDGET ACTIVITY 4 - Demonstration and Validation				PE NUMBER AND TITLE 0603790F NATO Cooperative Research and Development				PROJECT NATO		
<b>(U) B. <u>Budget Acquisition History and Planning Information Continued (\$ in Thousands)</u></b>										
<b>Government Furnished Property:</b>										
<u>Item Description</u>	<u>Contract Method/Type or Funding Vehicle</u>	<u>Award or Obligation Date</u>	<u>Delivery Date</u>	<u>Total Prior to FY 1998</u>	<u>Budget FY 1998</u>	<u>Budget FY 1999</u>	<u>Budget FY 2000</u>	<u>Budget FY 2001</u>	<u>Budget to Complete</u>	<u>Total Program</u>
<u>Product Development Property</u>										
None										
<u>Support and Management Property</u>										
None										
<u>Test and Evaluation Property</u>										
Fora laser system	PO	Nov 97	Jan 98	147	0	0	0	0	0	147
Identified as a source for SBIR				0	0	139	0	0	0	0
Subtotal Product Development				7,427	8,705	3,008	4,098	4,615	Cont	Cont
Subtotal Support and Management				1,665	700	301	145	943	Cont	Cont
Subtotal Test and Evaluation				675	938	657	40	0	Cont	Cont
Total Project				9,767	10,343	4,105	4,283	5,558	Cont	Cont
Project NATO										

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