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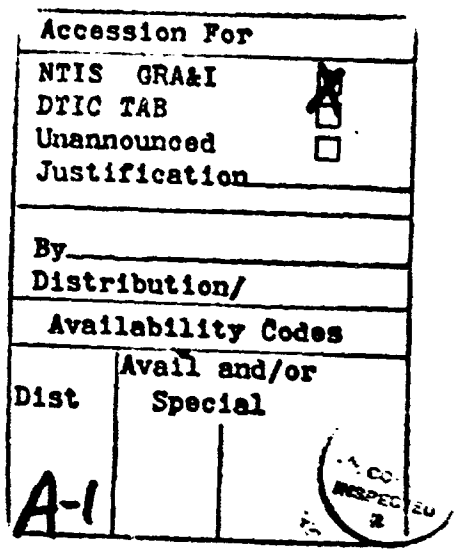
AMENDED FY 1988/1989 BIENNIAL BUDGET JUSTIFICATION OF ESTIMATES SUBMITTED TO CONGRESS

FEBRUARY 1988

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES
SUMMARY BY BUDGET ACTIVITY
($ IN THOUSANDS)

		FY 1987 ACTUAL	FY 1988 ESTIMATE	FY 88-89 PRES BUD FY 1989	CHANGE	AMENDED FY 1989 ESTIMATE
1.	TECHNOLOGY BASE	503,288	638,775	624,986	(98,683)	526,303
2.	ADVANCED TECHNOLOGY DEVELOPMENT	251,774	220,133	289,646	(49,200)	240,446
6.	DEFENSEWIDE MISSION SUPPORT	24,444	20,634	20,410	(1,313)	19,097
	TOTAL RDT&E - DIRECT	779,506	879,542	935,042	(149,196)	785,846
	REIMBURSEMENTS	14,217	10,000	10,000	--	10,000
	TOTAL PROGRAM	793,723	889,542	945,042	(149,196)	795,846



DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES
SUMMARY BY PROGRAM CATEGORY
($ IN THOUSANDS)

	FY 1987 ACTUAL	FY 1988 ESTIMATE	FY 88-89 PRES BUD FY 1989	FY 1989 CHANGE	AMENDED FY 1989 ESTIMATE
6.1 RESEARCH	98,006	80,000	122,535	(33,043)	89,492
6.2 EXPLORATORY DEVELOPMENT	405,282	558,775	502,451	(65,640)	436,811
6.3 ADVANCED DEVELOPMENT	251,774	220,133	289,646	(49,200)	240,446
6.4 ENGINEERING DEVELOPMENT	--	--	--	--	--
6.5 MANAGEMENT AND SUPPORT	24,444	20,634	20,410	(1,313)	19,097
TOTAL RESEARCH & DEVELOPMENT (PROGRAM 6)	779,506	879,542	935,042	(149,196)	785,846
TOTAL OPERATIONAL SYSTEM DEVELOPMENT	--	--	-		--
TOTAL RDT&E - DIRECT	779,506	879,542	935,042	(149,196)	785,846
REIMBURSEMENTS	14,217	10,000	10,000		10,000
TOTAL PROGRAM	793,723	889,542	945,042	(149,196)	795,846

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AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

Title: Defense Research Sciences
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number	Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
CCS-02	Advanced Digital Structures and Network Concepts:	16,197	26,590	29,947	Continuing
CCS-03	Modernization Technology	6,630	2,742	1,104	Continuing
DRG-01	Geophysical Research	1,880	1,921	2,600	Continuing
DRH-01	Systems Sciences	12,693	6,932	8,500	Continuing
DRT-01	Armor Materials Research	9,520	4,500	5,000	Continuing
ES-01	Electronic Sciences	24,103	22,938	21,139	Continuing
MS-01	Materials Sciences	17,953	14,377	21,202	Continuing
TOTAL FOR PROGRAM ELEMENT		88,976	80,000	89,492	Continuing

B. BRIEF DESCRIPTION OF ELEMENT: The Defense Research Sciences program element provides the technical foundation for long-term improvements in military equipment and systems through the discovery of new phenomena and the exploration of the potential of such phenomena for military application. Projects CCS-02, Advanced Digital Structures and Network Concepts, ES-01, Electronic Sciences, and MS-01, Materials Sciences in the Program Element are discussed in the individual project descriptions. The Modernization Technology Project is developing inexpensive, tethered platforms for rapid elevation of sensors and communications antennas from tactical vehicles. Terrain masking effects and line-of-sight requirements for modern command and control systems constrain the commander's choice of locations for deployment of critical assets. The requirements for connectivity and observation conflict with requirements for survivablility of expensive and critical resources. Current mast technology for elevating command and control systems is severely limiting in elevation provided and manpower/time required to deploy. The development of small, lightweight and inexpensive ducted-fan platforms will provide the ability to rapidly lift payloads to hundreds of feet of elevation versus current mast technology which can push payloads to only tens of feet. The Geophysical Research Project aims to improve yield determination of Soviet underground nuclear explosions and discrimination of earthquakes, quarry blasts, and decoupled underground nuclear explosions. Discrimination research is aimed at having the best possible verification capabilities available to verify compliance with the Threshold Test Ban Treaty, and to verify compliance in the event of a low-yield or comprehensive test ban treaty. The Systems Sciences Project involves research in the following areas: Advanced biosensor design/fabrication; very large scale

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E Title: Defense Research Sciences
Budget Activity: 1. Technology Base

integrated (VLSI) neural net chip fabrication; bio-organic materials for advanced sensor applications and naval countermeasure exploitation; advanced applied mathematical techniques for clustering algorithms to distinguish different emitters - radar, anti-submarine warfare (ASW), dense electronic warfare (EW); automatic personal computer system for high speed exact image compression and regeneration; and adaptive vehicle technology. Under the Armor Materials Research Project, research is performed to support all aspects of the Armor Program in program element number 0602702E, Tactical Technology. Included areas of effort are: low-cost processing of ballistic ceramics; development of new alloys and processing methods for tungsten; development of light-weight, high strength cermets; fundamental investigations of the physical mechanisms of armor penetration; computational penetration mechanics and improvements in modelling high rate deformation and failure; and studies of the thermo-chemical processes in explosive detonation and deflagration/detonation transitions.

C. PROGRAM ACCOMPLISHMENTS AND PLANS: Projects CCS-02, Advanced Digital Structures and Network Concepts, ES-01, Electronic Sciences, and MS-01, Materials Sciences in the Program Element are discussed in the individual project descriptions.

1. Project Number CCS-03, Modernization Technology:
   FY 1987 Program: Two versions of tethered, ducted-fan platform developed and evaluated
   FY 1988 Planned Program: First field demonstration model developed and integrated into tactical vehicle.
   FY 1989 Planned Program: Field demonstration model provided to Army for evaluation. Additional copies developed to support technology evaluation by services.
   Program to Completion: Technology development transfers to services by FY 1990.

2. Project Number DRG-01, Geophysical Research:
   FY 1987 Program:
   - Measurement of short period surface waves from Soviet shots at Novaya Zemlya; and practical use for yield estimation.
   - Determination of effects of lateral refraction on Novaya Zemlya surface wave yield estimates.
   - Development of improved equation of state for brittle rock under high stress, and application to coupling of underground nuclear explosions.

   FY 1988 Planned Program:
   - Determination of relative coupling at Soviet test sites by direct laboratory measurements on field samples from the Soviet Union.
   - Determination of accuracy of CORRTEX method for yield estimation in rocks at the Soviet test sites.
   - Development of graphics techniques and geophysical and satellite data bases to make relevant information rapidly available to the

analyst who is attempting to discriminate an event.

FY 1989 Planned Program:

- Use laboratory, field, and finite difference techniques to understand a discriminant which appears very promising: the ratio at regional distances of shear to compressional phases in the 4-8 Hz range.
- Understand and exploit for determination of Soviet yields the high precision of scattered seismic phases.

Program to Completion: This is a continuing program.

3. Project DRH-01, Systems Sciences:

FY 1987 Program:

- Demonstrated 10 decibel (dB) suppression of ocean surface-generated acoustic noise by monolayer biosurfactants.
- Demonstrated membrane stabilization for solid-state electrochemical sensor.
- Demonstrated stable silicon-based neural chips featuring both reversibility and continuous gray-scale.
- Developed image compression algorithms 1,000 times more powerful than previous methods.
- Completed outdoor testing of the hexapod vehicle.

FY 1988 Planned Program:

- Demonstrate utility of reverse bias silicon (RBS) biosensor in pathogen detection.
- Complete clustering algorithm software for ASPEN machine.
- Formulate multigrid methods for stress-related optimization problems.
- Control dynamically balanced vehicles on rough terrain.

FY 1989 Planned Program:

- Demonstrate ability to chemically modify the surfaces of self assembling tubules (SAT), and evaluate SAT lyotropic effects for controlled microstructure fabrication.
- Demonstrate utility of RBS biosensor in multi-target operation.
- Complete algorithms, software and machine design for automatic high speed image compression system of real world images.
- Transfer adaptive vehicle program to program element 0602301E, Strategic Technology.

Program to Completion: This is a continuing program.

4. Project DRT-01, Armor Materials Research:

FY 1987 Program:

- Developed diagnostic tools to evaluate ballistic events in armor penetration experiments.
- Developed materials for armor appliques and shaped charge warheads.
- Achieved breakthrough in processing of tungsten alloys that promises substantial improvement in performance of anti-armor projectiles.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

Title: Defense Research Sciences
Budget Activity: 1. Technology Base

FY 1988 Planned Program:
- Complete diagnostic tools for armor penetration experiments.
- Begin work to understand the physical mechanisms of armor penetration and model the penetration phenomena with computer calculations.
- Transfer work on improved tungsten and depleted uranium alloys to industrial teams in the Armor/Anti-Armor Program in Program Element Number 0602702E.
- Continue research on novel materials and concepts for armor and anti-armor.

FY 1989 Planned Program:
- Supplement research on physical mechanisms and mechanics of armor penetration by dynamic materials property measurements on materials of interest for armor applications.
- Continue basic research on armor and anti-armor materials.

Program to Completion: This project provides basic technology that will be utilized almost immediately by development efforts in the Armor/Anti-Armor Program in Program Element Number 0602702E, Tactical Technology and the Balanced Technology Initiative (BTI). The project is planned for completion in FY 1992.

D. WORK PERFORMED BY: Projects CCS-02, Advanced Digital Structures and Network Concepts, ES-01, Electronic Sciences and MS-01, Materials Sciences in the Program Element are discussed in the individual project descriptions.

1. Project Number CCS-03, Modernization Technology: The tethered, ducted-fan platform is being developed by Perceptronics, Woodland Hills, California, Moller Corporation, Davis, California, and the Naval Research Laboratory, Washington, D.C.

2. Project Number DRG-01, Geophysical Research: Performers include: California Institute of Technology, Pasadena California; Massachusetts Institute of Technology, Boston, Massachusetts; Southern Methodist University, Los Angeles, California; St. Louis University, St. Louis, Missouri; and University of California, Berkeley, California.

3. Project Number DRH-01, Systems Sciences: Performers include: Harvard University, Cambridge, Massachusetts; The Jet Propulsion Laboratory of the California Institute of Technology, Pasadena, California; Hughes Research Laboratory, Malibu, California; AT&T Technologies, Inc., Whippany, New Jersey; and the Virginia Polytechnic Institute & State University, Blacksburg, Virginia.

4. Project Number DRT-01, Armor Materials Research: The Los Alamos National Laboratory, Los Alamos, New Mexico, performs the great

Program Element: #0601101E

Title: Defense Research Sciences
Budget Activity: 1. Technology Base

majority of the work under this project.

E. RELATED ACTIVITIES: Projects CCS-02, Advanced Digital Structures and Network Concepts, ES-01, Electronic Sciences and MS-01, Materials Sciences in the Program Element are discussed in the individual project descriptions. There is no unnecessary duplication of effort within the Department of Defense for the research performed under this program element.

1. Project Number CCS-03, Modernization Technology: None.

2. Project Number DRG-01, Geophysical Research: There is no other substantial source of basic research funding in nuclear test-ban treaty geophysics. Developments in the research program are assured of transfer to applied programs by attendence at yearly research review meetings of all appropriate governmental agencies.

3. Project Number DRH-01, Systems Sciences: Work is coupled to Tri-Service needs through DARPA agents, annual program reviews, quarterly topical reviews and inter-agency working groups. The annual and quarterly reviews are open to DoD, industry and academic participation. These activities assure no unnecessary duplication of efforts occurs.

4. Project Number DRT-01, Armor Materials Research: This project provides basic research to support: the Armor/Anti-Armor Program in program element number 0602702E, Tactical Technology, and the Balanced Technology Initiative. The Armor/Anti-Armor Program has a joint program office (JPO) which has representation from the Army and Marine Corps to preclude duplication of efforts.

F. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E Title: Defense Research Sciences
Project Number: CCS-02 Budget Activity: 1. Technology Base
Project Title: Advanced Digital Structures & Network Concepts

A. RESOURCES: ($ in Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Advanced Digital Structures & Network Concepts	16,197	26,590	29,347	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The objective is to develop the fundamental technology in advanced digital structures and network concepts for smaller, more powerful and less expensive distributed military information processing systems. Design methodologies and tools are being developed for Very Large-Scale Integrated technology which reduce design time and cost, and produce better designs for DoD applications. System and Network concepts are being explored for use in future Communications, Command & Control architectures which will lead to survivable systems which are easier and faster to use. User interface techniques are being developed which simplify access to distributed resources and anticipate the intent of the user. Concepts for partitioning systems are being developed whereby a system can continue to function at a usable level of capability after being split or prior to merging into an integrated system. Techniques are being developed to facilitate resource sharing among computers and provide easy construction of tailored service units by the user.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- The first release of Berkeley's OCT/VEM design system with 20 associated tools is now in distribution. A domain-independent shell was developed by Rutgers and demonstrated for both VLSI and mechanical designs. CMU completed a release version of COSMOS, a compiled simulator for MOS logic. USC developed a methodology for modeling all important aspects of known testable design approaches. Stanford demonstrated a prototype for a process design language.
- The USC/ISI MOSIS VLSI brokering service supported over 100 organizations with approximately 2,000 design projects.
- Many new results have been derived from MIT for parallel algorithms and complexity. The architectural design and specifications of Cal Tech's second generation cosmic cubes was completed. Fully functional MIPS-X chips were completed at Stanford and successfully fabricated. The first full-scale (512x512 pixels) prototype of the VLSI-based architecture for UNC's Pixel-Planes raster graphics was completed and demonstrated.
- Research in cooperative interactive systems provided a methodology for building information services which share a natural, easy-to-use interface that is consistent across different systems.
- Development began on user interfaces that maintain the underlying consistency of a workstation environment while customizing that same environment for specific users using a semantic model of available functions and data.

Program Element: #0601101E Title: Defense Research Sciences
Project Number: CCS-02 Budget Activity: 1. Technology Base
Project Title: Advanced Digital Structures & Network Concepts

- A modular, object-oriented, database management system extensible to new applications was augmented to provide priority processing of time-critical data.
- Automated techniques for robust estimation of phoneme model parameters was demonstrated.

FY 1988 Planned Program:

- Demonstrate new design capabilities for advanced computer architectures based on Complementary Metal Oxide Semiconductor (CMOS), wafer-scale technology and Gallium Arsenide (GaAs) technology.
- Begin development of a uniform workstation interface for use as the main interface mechanism for the next-generation operating system, called MACH.
- Two trial database systems, which use an extensible system prototype, are beginning implementation and evaluation.
- In speech recognition, techniques will be developed to enhance the robustness of acoustic-phonetic features.

FY 1989 Planned Program:

- Integrated design systems that use hardware accelerators, will be developed, which allow designers to deal with the complexity of sub-micron designs, mixed technologies, and system synthesis.
- Demonstrate a uniform workstation interface for users in a very large distributed environment, and develop a large, complex software system based in MACH.
- Improve languages and techniques for robotic instruction used to interact with human assistants.
- In well understood task domains, simple robotic prototypes will be demonstrated performing numerous complex perceptual and reasoning tasks with little or no direction from humans except for instruction of very general goal conditions. Emphasis will be on robotics in manufacturing tasks.
- Testbed activities at this time will capitalize on previous DARPA funded research in machine perception and robotic planning.

Program to Completion:

- Advanced silicon compiler technology will be developed and this design technology will be extended to other design disciplines. Very Large Scale Integrated architecture and design efforts will focus on development of integrated capabilities for the design, fabrication, and test of integrated circuits containing in excess of one million gates and for the rapid prototyping of systems containing circuits of this complexity.
- Continue experimentation in advanced computing architectures with major emphasis placed on rapid prototyping of very high-performance special purpose accelerators, which operate and interface to emerging architectures and systems.

Program Element: #0601101E Title: Defense Research Sciences
Project Number: CCS-02 Budget Activity: 1. Technology Base
Project Title: Advanced Digital Structures & Network Concepts

- Research in speech will produce connected-word speech systems that can perform simple functions such as database retrieval and machine operating system commands.
- Intelligent user interfaces will combine natural language and graphic outputs, and user models that anticipate work session scenarios will be implemented. Operating and network management systems will result in robust, survivable systems that continue to provide local utility in the face of major global outages.
- Methods of using computing power to aid in collaboration for staff design and planning functions will be extended to support geographically distributed domains.

D. WORK PERFORMED BY: The major performers are University of Southern California/Information Sciences Institute, Marina del Rey, California; Stanford University, Stanford, California; Massachusetts Institute of Technology, Cambridge, Massachusetts: MIT Lincoln Laboratory, Lexington, Massachusetts; University of California at Berkeley, Berkeley, California; and Defense Communications Agency DECCO, Belleview, Illinois.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY: No change.

F. PROGRAM DOCUMENTATION: Not Applicable.

G. MILESTONE SCHEDULE:

Plan	Milestones
Dec 1988	Develop a uniform workstation interface for the next-generation operating system (MACH).
May 1988	Demonstrate a system to enhance the planning and collaborative performance of a VLSIC design group.
May 1988	Develop robust acoustic-phonetic features that enhance speech recognition.
May 1988	Demonstrate a wafer-level design system.
Sep 1989	Demonstrate a uniform workstation user interface and stress it by developing large bodies of software.

H. RELATED ACTIVITIES:

- The work provides the technical base for other DARPA program areas, particularly Program Element #0602301E, Strategic Technology, ST-10, Strategic Computing.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
Project Number: MS-01
Project Title: Materials Sciences

Title: Defense Research Sciences
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Materials Sciences	$17,953	$14,377	$21,202	Continuing

B. BRIEF DESCRIPTION OF ELEMENT: New materials and concepts for advanced metal matrix composite structures; novel processing for ceramics and ceramic composites; synthesis of stronger and more heat resistant polymers; solid lubrication for high temperature wear reduction; and radar absorbing materials and structures.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program

- Extended the Lanxide process for converting molten metals into ceramics to produce ceramic composites with extremely high toughness
- Increased the high temperature creep strength of materials by a factor of three through the Exothermic Dispersion (XD) process of fabricating metal matrix composites required for advanced missiles and hypersonic aircraft
- Demonstrated enhanced performance of composite structures for radar protection under conditions of stress and temperature
- Initiated a program to develop composite polymer blends which have excellent high temperature strength

FY 1988 Planned Program:

- Demonstrate net shape forming of Lanxide ceramic composites for low cost armor tiles and gun barrel liners.
- Achieve increased fracture toughness of brittle matrix composites by designing weak interfaces between the matrix and reinforcing fibers
- Develop intermetallic niobium-base alloys to increase the turbine inlet temperature of engines by 300 to 500 degrees centigrade
- Utilize microwave processing of polymers to synthesize solar blankets for spacecraft protection

FY 1989 Planned Program:

- Evaluate solid lubricants in special tribotester to determine upper temperature operational limits
- Fabricate composites with low observable properties into components and evaluate the components
- Optimize Lanxide ceramic composites for high temperature strength to improve structual materials and components for missiles and aircraft

Program Element: #0601101E
Project Number: MS-01
Project Title: Materials Sciences

Title: Defense Research Sciences
Budget Activity: 1. Technology Base

- Achieve operational temperatures three times higher than those achievable using graphite/epoxy through polymer blend composites reinforced with graphite fibers

PROGRAM TO COMPLETION:

- Demonstrate Lanxide ceramics as improved applique armor
- Fabricate advanced titanium metal matrix composites into components for missiles and aircraft.
- Develop improved radar absorbing structures for airframes and engines.
- Demonstrate niobium intermetallics in high temperature turbine blade application

D. WORK PERFORMED BY:: Major performers include: Lanxide Corporation, Newark, Delaware; Hughes Aircraft Company, Los Angeles, California; Celanese Corporation, Newark, New Jersey; Pratt and Whitney Corporation, West Palm Beach, Florida; and Virginia Polytechnic Institute, Blacksburg, Virginia.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

Change	Schedule	Schedule Change	Budget Year Cost ($000)
Cost	Synthesis of adhesives capable of withstanding up to 450°C with extended service life	Cancelled	-$2,296
Cost	Fabricate composites (radar absorbing materials) with low observable properties	Delayed to May 1990	-$2,100

NARRATIVE DESCRIPTION OF CHANGES

COST CHANGES: Budgeting reductions force both a phase out of the high temperature polymer adhesives program and a 9 month delay in implementation of several projects in the radar absorbing material/radar absorbing structure (RAM/RAS) program.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
Project Number: MS-01
Project Title: Materials Sciences

Title: Defense Research Sciences
Budget Activity: 1. Technology Base

F. PROGRAM DOCUMENTATION: Not Applicable.

G. MILESTONE SCHEDULE:

Plan	Milestones
Sep 1988	Demonstrate coupon-sized radar absorbing composite structure which can sustain extreme environments
Sep 1988	Demonstrate applicability of Lanxide technology to ceramic armor and ceramic composite gun barrel liners
Sep 1988	Develop synthesis of polymers capable of withstanding up to 450°C with extended service life
May 1989	Establish approaches for the solid lubrication of ceramics in sliding wear at both high (650°C) and low (-50°C) temperatures
Dec 1989	Develop new niobium based intermetallics for high temperature turbine applications up to 1400°C
Oct 1990	Fabricate composites (radar absorbing materials) with low observable properties
Dec 1990	Initiate work to fabricate an engine exhaust component exhibiting low observable properties during operation

H. RELATED ACTIVITIES: DARPA's research on Materials Processing Technology is coordinated within the DoD and with other federal agencies via the NSF-hosted Interagency Materials Group, OSTP's Committee on Materials, and various DDP&E sponsored topical workshops on composite materials. These activities assure that no unnecessary duplication of effort occurs.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
Project Number: ES-01
Project Title: Electronic Sciences

Title: Defense Research Sciences
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Electronic Sciences	$24,103	$22,938	$21,139	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES:
The objective of this project is to explore and demonstrate device, material, and material processing concepts which will provide: (1) new technical options for implementation of future electronic and optical systems and functions for information transmission, gathering and processing; and (2) substantial increases in performance, survivability, reliability, and availability of electronic components and monolithic, high throughput circuits at reduced cost per function. Specific areas are: innovative semiconductor processing and device design concepts; electronic and optically active polymers; monomolecular thin film structures; photorefractive materials and devices for achieving optical beam modulation and steering; nonlinear optical effects for optical computing; and signal processors using acoustic charge transport (ACT) technology.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:
FY 1987 Program:

- Demonstrated 0.7% compositional uniformity from heteroepitaxy of mercury cadmium telluride (MCT) on 2 inch diameter gallium arsenide (GaAs) wafers
- Demonstrated heterojunction bipolar transistor research devices with a frequency cut-off for power gain (fmax) as high as 175 gigahertz (GHz)
- Measured permeable base transistors (PBT) to have a 45% power added efficiency at 22 GHz with two devices able to deliver over 400 milliwatts of power
- Multi-wavelength light emitting diodes (LED's) have been proven feasible in monolithic chip by laser assisted molecular beam epitaxy (MBE) of gallium-aluminum-arsenide
- Demonstrated the first optical processing device to be fabricated in an organic material - a waveguide electro-optic modulator. Research continued to improve the modulator performance over the past several months, increasing the frequency response to 200 kilohertz (KHz) and lowering the voltage to 4 volts
- Demonstrated a laser diode using a threshold current of less than 1 milliamp, an order of magnitude improvement over previous threshold levels
- Achieved two dimensional (2-D) image switching from one beam to another in GaAs - the first demonstration of optically addressed GaAs spatial light modulation
- Achieved continuous operation of a laser diode fabricated in GaAs that was grown on a silicon substrate - the most complex device demonstration to date in the very promising heterostructure of GaAs on silicon
- Completed fabrication and test of hybrid ACT feasibility models of the following devices: analog memory (400 megahertz (MHz) bandwidth, 40 decibel (db) dynamic range and 12.5 microsec hold); stationary vector processor (200 MHz, 60db, 256 time bandwidth product); psuedo noise correlator (80MHz, 50db, 400 processing gain); adaptive vector processor (200 megahertz (MHz), 60 decibel (db), 256 time bandwidth product).

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
Project Number: ES-01
Project Title: Electronic Sciences

Title: Defense Research Sciences
Budget Activity: 1. Technology Base

FY 1988 Planned Program:

- Continue materials and device efforts directed toward achieving millimeter wave, three terminal devices with emphasis placed on achieving high efficiency and power in the millimeter wave region
- Continue realistic electronic structure and device modelling efforts in order to provide guidance for the experimental materials and device research
- Develop electro-optical measurement techniques with subpicosecond resolution for investigating the physics of ultra high speed structures and as a potential replacement for slower, cumbersome electrical approaches
- Initiate a program to investigate the potential of gallium arsenide (GaAs) microwave, wafer scale, transmit, receive (T/R) cells to realize a thin, conformable low radar cross section antenna
- Expand materials and device research programs to develop laser source and detector technology for optical satellite communications
- Create improved photorefractive materials for light modulation and nonlinear materials for optical switching
- Continue investigations of novel devices exploiting the capabilities of focussed ion beam technology to expand the performance of high-frequency devices for military applications
- Explore such areas as gallium-arsenide-on-silicon heteroepitaxy, very-high-speed tunneling transistors, and materials characterization techniques; continue exploration of superlattice and other small-dimension structures for novel electronic and optoelectronic applications
- Complete monolithic fabrication of interface and processing circuits directly on the same GaAs substrate with acoustic charge transport (ACT) device

FY 1989 Planned Program:

- Use device designs that have yielded successful demonstrations of millimeter-wave operation in monolithic implementations that contain both the active and passive devices needed for monolithic millimeter wave (mm-wave) phased array modules
- Apply Monomolecular Langmuir-Blodgett films to novel materials and device structures to evaluate the passivation potential of these films
- Identify potential applications of semiconductor superlattices, in which scientists can tailor crystal properties as desired by adjusting material compositions and layer thicknesses
- Continue development of processing technology for submicrometer feature sized digital and analog circuits
- Continue exploration of electronic and optical polymers for unique properties of significance to DoD applications and optical techniques for symbolic computing
- Initiate work into realizing optical neural networks and expand research into novel devices based on organic and polymeric materials that are emerging from the existing nonlinear optical materials thrust
- Continue development on monolithic ACT technology along with demonstration and testing of the optimized programmable transverse filter

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
Project Number: ES-01
Project Title: Electronic Sciences

Title: Defense Research Sciences
Budget Activity: 1. Technology Base

Program to Completion: Expand new efforts in technology applications of monomolecular films, superlattices, electronic polymers, and three dimensional circuit structures. Continue the submicron materials and device physics effort due to the far-reaching operational significance which accompanies success, and the extreme technical challenge involved. Continue efforts in extremely high frequency device and material structure due to their emerging importance in supercomputation and secure communications as well as electronic warfare. Continue monolithic integration of optimized acoustic charge transport (ACT) devices with control and interface circuitry to form practical Analog/Digital array processors. This is a continuing program.

D. WORK PERFORMED BY: Performers include: Rockwell International Science Center, Thousand Oaks, California; Westinghouse Research Center, Pittsburgh, Pennsylvania; Celanese Research Center, Summit, New Jersey; Stanford University, Palo Alto, California; and the Lincoln Laboratory, Lexington, Massachusetts.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY: No significant changes.

F. PROGRAM DOCUMENTATION: Not Applicable.

G. MILESTONE SCHEDULE:

Plan	Milestone
Aug 1988	Complete evaluation of alternative mercury telluride systems for improved infrared detecting material systems vis-a-vis mercury cadmium telluride
Aug 1988	Complete fabrication and test of ACT monolithic devices
Aug 1988	Demonstrate 94 gigahertz (GHz) permeable base transistor amplifier
Jan 1989	Demonstrate an optical inference machine based on either matched filtering or template matching
Jan 1989	Demonstrate the growth of gallium arsenide (GaAs) thin films on silicon substrate using low temperature beam processing
Aug 1989	Demonstrate Optical S-parameter measurement capability for 100 GHz transistor evaluation
Sep 1990	Demonstrate stark-effect transistor
May 1991	Demonstrate reconfigurable optical interconnect device

H. RELATED ACTIVITIES: Developments in electronic materials, device concepts, and processing methods are coupled to the services' programs through the DARPA agents, annual DoD-wide program reviews, and coordination through the DDR&E's Advisory Group on Electron Devices (AGED). These activities assure that no unnecessary duplication of effort occurs.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602101E

Title: Technical Studies
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number	Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
	TOTAL FOR PROGRAM ELEMENT	0	$1,700	$1,800	Continuing

B. BRIEF DESCRIPTION OF ELEMENT: This program provides independent, topical, in-depth studies and analyses is support of the Office of the Under Secretary of Defense for Acquisition OUSD(A), and its various component offices. Each year the most urgent subjects are chosen by the directors of Strategic and Theater Nuclear Forces, Tactical Warfare, Research and Advanced Technology and others. The Institute for Defense Analyses (IDA) provides in-depth answers to current and anticipated future problems assisting the decision makers to make better informed judgements and decisions.

C. PROGRAM ACCOMPLISHMENTS AND PLANS: The OUSD(A) plans for IDA work in FY 1988 include studies in Improvement of Chemical Capabilities, Improved Battlefield Nuclear Deterrence, Electronic Techniques for Surveillance, Target Acquisition and Selection, Aircraft Systems Laser Survivability, High Temperature Superconductivity, Relative Assessment of Technology Payoffs, Technology to Reduce Weapon Systems Support Requirements, Anti-Armor Munitions Master Plan, Human Factors Engineering Design, and Competent Munitions. Program plans for FY 1989 and FY 1990 are not fully formulated at this time. However, it is envisioned that some work will be extensions of work initiated in FY 1988. Political and military situations that may develop between now and FY 1990 may necessitate rapid revisions. Tentative plans envision studies in Regional Maritime Air Supersuperiority, Shipboard Local Area Defenses Combat System, Tactical Laser Designators, ADP for USMC Fire and Air Support, Integrated Strategic Defense, and Follow-on Force Attack Analyses. This is a continuing program with no set completion target.

D. WORK PERFORMED BY: This research is performed by the Institute for Defense Analyses (IDA), Alexandria, Virginia (FFRDC, 100%).

E. RELATED ACTIVITIES: The work performed under this program element is related to and contributes data to the program management activities of OUSD(A). Specific offices that have been supported include those of the Deputy Under Secretaries, Defense Acquisition (DUSDA) for: Research and Advanced Technology; Tactical Warfare Programs; Strategic and Theater Nuclear Forces; and International Programs and Technology.

F. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: 0602301E Title: Strategic Technology
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

	Project Number	Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
	ST-01	Advanced Strategic Concepts and Technical Analysis	$25,642	$16,310	$17,779	Continuing
	ST-09	Submarine Laser Communications	$12,445	0	0	$194,000
	ST-10	Strategic Computing	$102,697	$131,219	$126,133	Continuing
	ST-11	Intelligent Systems	$26,648	$29,613	$30,600	Continuing
	ST-12	Advanced Quantum Electro-Optics	$9,740	$23,606	$17,147	Continuing
	ST-13	Broad Area Search and Surveillance	$6,500	$5,402	$10,681	Continuing
**	ST-14	LIGHTSAT	0	$35,000	0	Continuing
	ST-15	ManTech	0	$19,050	0	$19,050
	ST-16	High Temperature Superconductivity	0	$15,000	0	$15,000
*	TOTAL FOR PROGRAM ELEMENT		$206,987	$311,500	$227,640	Continuing

B. BRIEF DESCRIPTION OF ELEMENT: This Program Element funds a varied and broad research and development program directed toward the development and application of advanced technologies associated with strategic system concepts; innovative strategic technologies; strategic computing; intelligent systems; advanced solid state lasers; surveillance and engagement techniques; manufacturing technology; and processing, fabrication and demonstration of high temperature ceramic superconductors.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

ST-15 FY 1988 Planned Program: (Manufacturing Technology)
- Initiate effort on concurrent engineering of critical components and assemblies, such as composite structures for aerospace applications, and assembly of avionics and guidance subsystems

** LIGHTSAT is described in Project EE-27; PE0603226E
* Totals include classified projects not identified herein

Program Element: #0602301E Title: Strategic Technology
Budget Activity: 1. Technology Base

- Establish concept and framework for microfactory test bed which addresses integration of new technologies into advanced manufacturing environments required for production of reliable, lower cost defense products
- Begin effort on advanced microelectronic customized device fabrication using flexible automated approached to eliminate high capital requirements that inhibit expansion of U.S. electronics production base.

ST-15 FY 1988 Planned Program:(High Temperature Superconductivity)

- Twenty one contracts will be made to institutions who successfully competed in the DARPA/ONR solicitation on Processing Fabrication and Demonstration of High Temperature Superconductors. Several additional contracts may be made based on unsolicited proposals, principally government laboratories and not-for-profit institutions who are not allowed to compete on open solicitations.
- The research will focus on both bulk superconductors which ultimately will be used for motors, generators, magnets, etc., and thin film materials for ultimate applications in electronic devices.
- Initial emphasis will focus on materials processing aimed at optimizing microstructure to enhance current carrying capability, magnetic behavior, mechanical strength and long term chemical stability.

D. WORK PERFORMED BY:

ST-15; Manufacturing Technology - To be determined

ST-16; High Temperature Superconductivity - The 21 institutions to enter negotiations with DARPA/ONR were announced on Jan 25, 1988 in a news release from the Office of Assistant Secretary of Defense (Public Affairs). They include large and small industries and universities. The announcement also lists the names of the subcontractors.

E. RELATED ACTIVITIES:

ST-15; Manufacturing Technology - Work is coupled to tri-service programs via agents and the Joint Director of Laboratories Task Group on Manufacturing

ST-16; High Temperature Superconductivity - Research on high temperature superconductors (HTS) is coordinated within DoD and with other federal agencies via the HTS subcommittee of OSTP's Committee on Materials, the DoD HTS Coordinating Committee, the NSF-hosted Interagency Materials Group, and numerous workshops involving industrial, university and government scientists and engineers.

F. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E Title: Strategic Technology
Project Number: ST-01 Budget Activity: 1. Technology Base
Project Title: Advanced Strategic Concepts

A. RESOURCES ($ in thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Adv Strategic Concepts & Tech Analysis	$25,642	$16,310	$17,779	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIRDMENT AND SYSTEM CAPABILITIES: This project identifies and evaluates advanced strategic concepts and technologies that have broad applicability to all the efforts of the Strategic Technology Office. The element establishes experimental efforts and studies that investigate the implications and potential of these technologies for future weapon systems designs and capabilities. These new initiatives make up the technology base for other program elements within the Strategic Technology Office and transition to them if successful.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- Bomber modernization issues defined
- Bomber force sustainability studied
- IR cloud transmission investigated
- Lightsat applications defined
- Clutter rejection and optical pre-processing techniques developed
- Trail detection algorithms verified
- Scanning sensor designed
- LWI detector arrays designed
- Techniques to find imprecisely located targets studied
- ECCM techniques developed
- Multistatic radar imaging techniques developed
- Saurex, a space manufacturing technique, investigated
- Monolithic X-band phase shifter designed
- Space object assisted reentry (SOAR) studied
- Holographic codings studied
- Image recognition research and tests planned
- Approximately $15.5 million of FY87 funds were spent on non-acoustic ASW efforts which are discussed in the TT-03 project description PE 0602702E.

FY 1988 Planned Program:

Study efforts in support of USDDR&E such as:

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E Title: Strategic Technology
Project Number: ST-01 Budget Activity: 1. Technology Base
Project Title: Advanced Strategic Concepts

- Complete study of bomber force modernization issues
- Analyze space defense issues
- Space transportation study
- Aerospace plane technologies
- Arms control issues
- Issues related to introduction of non-nuclear strategic weapons
- Mini-GPS Receiver Program - Develop low-cost hand-held GPS receiver that will allow precise geo-positioning.
- Non-nuclear Strategic Weapon Lethality - Experiments to determine lethality at zero-CEP type weapons.
- Advanced structure hardening technology vs. advanced conventional munitions.
- Hypersonic Aerodynamics - Experiments to define ability to precisely reenter ballistic vehicles and maintain CEP at hypersonic velocities.
- Laser Radar - Develop a well stabilized laser oscillator capable of attaining high resolution laser radar images over distances of interest to air defense and relocatable target identification.
- Target Identification - Experiments to demonstrate the ability of a spatial light modulation to perform target identification in the fourier plan.
- Space Based Radar - Define space experiment in tether radar and in using a distributed array.
- Saurex - Demonstrate space manufacturing techniques.
- Multi-static Radar - Experiments to determine effectiveness and clutter characteristics of multistatic radars.
- SOAR - Perform wind tunnel experiments to demonstrate supersonic parafoil performance.
- Superconducting Detectors - Experiments to investigate feasibility of using high temperature superconductors as detectors of electromagnetic indication.

FY 1989 Planned Program

- Continue study efforts as directed by USDDR&E
- Demonstrate Mini-GPS receiver performance
- Demonstrate non-nuclear strategic weapon lethality
- Conduct experiments in hypersonic aerodynamics
- Demonstrate laser radar
- Perform target identification experiments
- Conduct planning for space based radar experiment using tethers
- Conduct Space Based Radar distributed aperture experiment
- Demonstrate space manufacturing techniques
- Demonstrate high altitude parafoil performance
- Demonstrate infrared superconducting detector

Program to Completion: Continue to investigate concepts of importance to strategic technologies and to perform experiments that

Program Element: #0602301E Title: Strategic Technology
Project Number: ST-01 Budget Activity: 1. Technology Base
Project Title: Advanced Strategic Concepts

demonstrate the feasibility of these concepts. Transition successful investigations to the Strategic Technology Office's mission oriented elements.

D. WORK PERFORMED BY: Rockwell International, Cedar Rapids, Iowa; Institute for Defense Analysis, Alexandria, VA; MIT Lincoln Laboratory, Lexington, MA; Jaycor, San Diego, CA; Vanguard Research, Fairfax, VA.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARIES: No change.

F. PROGRAM DOCUMENTATION: Not Applicable.

G. MILESTONE SCHEDULE:

Plan	Milestone
	Mini-GPS Receiver
Mar 88	Develop GaAs RF/IF chips
Nov 88	Demonstration unit
	Non-Nuclear Lethality
Nov 88	Lethality tests of strike intercept sub-munitions
	Hypersonic Aerodynamics
Nov 88	Test reentry of strike intercepts sub-munitions
	Laser Radar
Nov 88	Demonstrate narrow linewidth cavity
Nov 89	Conduct imaging experiment
	Target Identification
Feb 89	Test of spatial light modulator at visionics lab
	Space Based Radar
Dec 88	Space radar tether experiment plan
Jun 89	Distributed array experiment plan
	Saurex
Dec 89	Space manufacturing demonstration
	SOAP
May 88	Parafoil supersonic windtunnel test
Mar 89	High altitude parafoil test
	Superconducting Detector
Jun 89	Demonstrate high temperature superconducting detector

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
Title: Strategic Technology
Project Number: ST-01
Budget Activity: 1. Technology Base
Project Title: Advanced Strategic Concepts

H. RELATED ACTIVITIES: The Advanced Strategic Concepts Project develops the technology for such other Strategic Technology efforts as Strategic Relocatable Targets (PE0603227E), Air Defense Technology (PE0602301E), and Hypersonic Weapons (PE0603226E).

I. OTHER APPROPRIATION FUNDS: None.

RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
Title: Strategic Technology
Project Number: ST-10
Budget Activity: 1. Technology Base
Project Title: Strategic Computing

A. RESOURCES: ($ in Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Strategic Computing	102,697	131,219	126,133	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The objective of the Strategic Computing Program is to develop and demonstrate a new generation of computer technology that can be exploited to create advanced military systems and to maintain U.S. world leadership in computer technology.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- Major milestones were accomplished in Military Applications (i.e., the Autonomous Land Vehicle (ALV) Program; the Navy Fleet Command Center Battle Management Project; the Pilot's Associate Program; the Synthetic Aperture Radar Project; the Airland Battle Management Project; and the Smart Weapons Program; Machine Intelligence (i.e., visual competence of the Strategic Computing Vision New Generation System was demonstrated in a new vehicle testbed); Multiprocessor System Architecture (i.e., a VLSI implementation for WARP programmable systolic array system was designed and functionally simulated); Applied and Computational Mathematics Program (ACMP) (i.e., developed an algorithm reducing processing time 10-fold for signal processing); and in the Infrastructure Program--RMOSIS (i.e., the secure Metal Oxide Semiconductor Implementation System (MOSIS), expanded its classified facility vendor base for 1.2 micron circuits).

FY 1988 Planned Program:

- The relationship between Autonomous Land Vehicle (ALV) performance and various software modules from the research community will be investigated. Demonstrations will be conducted for the Naval Fleet Command Center Battle Management Project (FCCBMP); Pilot's Associate Program; Airland Battle Management (ALBM) Program; Synthetic Aperture Radar (SAR) Project; and Smart Weapons Program.
- Multiprocessor system architectures will facilitate the transition of new-generation machine intelligence technologies in the applications. Transition of the New Generation Systems (NGS) to multiprocessor system architectures has begun.
- A parallel system architecture will be developed to work with the modular signal processing architecture. Prototype development of an advanced Connection Machine has begun using advanced technologies.
- The Applied and Computational Mathematics Program (ACMP) is beginning new initiatives in dynamical systems, turbulent flow in fluid dynamics, computational algorithms, and control theory--including a Mach 25 digital wind tunnel.
- The Metal Oxide Semiconductor Implementation System (MOSIS) continues to provide fabrication services for both silicon (Si) and Gallium Arsenide (GaAs) circuits, and special options to support analog design.

Program Element: #0602301E
Project Number: ST-10
Project Title: Strategic Computing

Title: Strategic Technology
Budget Activity: 1. Technology Base

FY 1989 Planned Program:

- Autonomous Land Vehicle's (ALV) integrated system will plan and execute a 5 kilometer long path over road networks and rough country terrain. The full prototype of the Capabilities Assessment Expert Systems (CASES) will be completed and integrated into the Commander-in-Chief, Pacific Fleet (CINCPACFLT) testbed. The Pilot's Associate Program will complete a near real-time demonstration and begin work towards a real-time demonstration. Airland Battle Management will demonstrate planning at the Corps and Division levels and fire support planning at the Corps level. The Strategic Image Exploitation testbed will be transferred to a selected operational facility for demonstration and technology evaluation. The technology base for automated screening of broad area Synthetic Aperture Radar (SAR) imagery will transition to advanced parallel architectures. In the Smart Weapons Program, Phase II software products will be integrated and tested in simulations and/or field experiments.
- A New Generation Vision System will demonstrate the integration of motion detection modules, terrain modeling modules, sensor fusion processes using the blackboard.
- In the architectures area, the basic scalable multiprocessor modules designs and prototypes will be aggressively developed.
- The Applied and Computational Mathematics Program (ACMP) will continue development of image/data compression algorithms, software and hardware, for the exact rapid compression and regeneration of real-world images.
- In the Micro-Electronics areas, the wideband opto-electronic 16 x 16 crossbar switch will be integrated into the MOSAIC parallel computer.
- Wafer-scale designs fabricated through the MOSIS prototyping service will demonstrate the capability to integrate the equivalent of tens of millions of transistors in a single 4" by 4" silicon substrate. Experimental system technology modules will be developed to rapidly implement systems based on modular hardware and software.

Program to Completion:

- The Autonomous Land Vehicle (ALV) will progress to full autonomy. The Airland Battle Management Program (ALBM) reaches full, planned, concept demonstration in FY 1991. Strategic Computing Vision (SCVision) research algorithms will be produced and disseminated to support work on many other military application systems.
- The Applied and Computational Mathematics Program (ACMP) will provide engineering tools to improve design capabilities for hypersonic and highly manueverable aircraft; a Digital Wind Tunnel; improved interpretation of oceanic surface signatures; and, a software system for vastly improved high speed exact image/data compression and regeneration.
- Integration of the equivalent of tens of millions of transistors on a single 4" x 4" silicon substrate will be possible.
- The developing technology base for optical interconnections will form the foundation for optical crossbar switches and intracomputer networks.

D. WORK PERFORMED BY: The major performers are University of Southern California/Information Sciences Institute, Marina del Rey, California; Bolt, Beranek and Newman, Cambridge, Massachusetts; Carnegie-Mellon University,

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E Title: Strategic Technology
Project Number: ST-10 Budget Activity: 1 Technology Base
Project Title: Strategic Computing

Pittsburgh, Pennsylvania; Martin Marietta, Denver, Colorado; and Texas Instruments, Dallas, Texas.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

Change	Schedule	Schedule Change	Budget Year Cost
Cost	Research efforts	1 year →	-6,993

NARRATIVE DESCRIPTION OF CHANGES

COST CHANGES: Budget reductions force 1 year or more delays in hardware and software efforts in FY 1989 and beyond. Delays will be experienced in the basic schedule multiprocessor module designs with the planned mid-1990 TERAOPS systems set back approximately 1 year. Additionally, the optical link demonstration for the connection will be rescheduled for a later time.

In battle management the delays will be experienced in the scheduled April 1990 JANUS-II, natural language interface and Division level maneuver planning and Corps-level fire support planning demonstrations.

Other delays will occur in advanced software development, optical interconnections for optical crossbar switches/intracomputer networks and engineering tools to improve design capabilities.

F. PROGRAM DOCUMENTATION: Not applicable.

G. MILESTONE SCHEDULE:

Plan	Milestones
Apr 1988	Demonstrate Capabilities Assessment Expert System (CASES) at the Naval Fleet Command Center Battle Management Project (FCCBMP) testbed. Demonstrate maneuver planning expert system at Corps level and a software development tool for Airland Battle Management (ALBM).
Apr 1988	Demonstrate screening of Synthetic Aperture Imagery for tactical targets and strategic bomber base vision expert system.
Sep 1988	Demonstration of monolithic integration of Gallium Arsenide (GaAs) laser diode and a silicon (Si) device.
Jan 1989	Demonstrate heterogeneous multiprocessor system and New Generation System (NGS) Vision system.
Sep 1989	Demonstration of high density packaging with 40 megahertz silicon processor.
Jun 1989	Demonstrate a 2,000 word continuous speech recognition system.
Jan 1991	Demonstrate optical links in the Connection Machine.
Feb 1991	Demonstrate JANUS-II, natural language interface.

H. RELATED ACTIVITIES: Program Element #0602301E ST-11, Intelligent Systems.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
Title: Strategic Technology
Project Number: ST-11
Budget Activity: 1. Technology Base
Project Title: Intelligent Systems

A. RESOURCES: ($ in Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Intelligent Systems	26,648	29,613	30,600	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The project investigates fundamental science and technology that promises exciting new intelligent information processing capabilities. This will enable computers to assist, advise, and/or relieve military personnel in complex decision-making tasks, including those related to systems development and maintenance and in tasks which are tedious, dangerous, or rapidly changing. The objectives of this program are to demonstrate new machine reasoning capabilities and intelligent robotic systems for field and industrial use. A major emphasis is rapid prototyping of next-generation software systems for Defense needs which are flexible, robust, and cost effective. The specific approach continues to be fundamental development at the frontiers of artificial intelligence (AI) and advanced robotic systems. As specific areas and technologies show strong promise for further exploitation and large-scale development, they will be transferred to other DARPA programs such as the Strategic Computing Program (ST-10).

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- An image understanding system framework was developed that integrated high and low level vision. This framework allowed total system experimentation combining new low-level image feature analysis techniques with other feature specific sources of knowledge.
- Parallel algorithms were explored to improve the efficiency of image understanding and to gain a better understanding of new multi-processor hardware that became available in other DARPA programs.
- A system for generation of database management modules was demonstrated with the focus on very high performance processing.
- A new class of shared knowledge management systems was developed for spatial and temporal data management and recursive query facilities.
- An empirical analysis of a distributed problem solving system was conducted to better understand high-level distributed control for fault-diagnosis, load balancing, and organization.

FY 1988 Planned Program:

- In image understanding, methods for estimating motion from "noisy" data are being demonstrated in an experimental mobile robot.
- Improvements in speed, accuracy, and robustness of certain image understanding algorithms are being demonstrated.
- A new approach to building powerful and adaptive problem solving systems based on the case-based reasoning paradigm is being demonstrated in a military task domain.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
Title: Strategic Technology
Project Number: ST-11
Budget Activity: 1. Technology Base
Project Title: Intelligent Systems

- Systems that effectively couple the flexibility of intelligent systems with the principled structure and efficiency of database systems are being developed and applied to military problems.
- A generic distributed problem-solving architecture that includes the control and data flow relationships among the meta-level control components is being developed.
- A new experimental software and systems evolution environment is being designed containing extensible subsystems for object management, knowledge representation, reasoning, transformation, specifications, and user interfaces.
- In cooperation with Project MPT-01 (Defense Sciences), design of an advanced robotic manipulator will start, research will continue toward the development of micro electro-mechanical sensors and actuators, and research will continue on dynamically balanced vehicles. Major three-year efforts will be started to improve our ability to program and control robotic manipulators.

FY 1989 Planned Program:

- A major experimental testbed for integrating low, intermediate, and high level visual operations on complex images of either natural scenes, as might be needed for photo interpretation tasks, or indoor scenes, as might needed for industrial robotics tasks, will be developed.
- Two important issues in integrated machine perception and cognition will be explored using the visual operations testbed: 1) focus of attention - processing only relevant sensory data; and 2) complex control strategies which orchestrate the operations chosen for the images.
- Multiple problem-solving paradigms will be tested to explore their performance and adaptability on difficult human tasks.
- The advanced robotic manipulator (ARM), based upon previous work in the technology base (MPT-01), will be ready for system testing. Several kinds of micro electro-mechanical sensors will be built and tested. Design will start on a dynamically balanced vehicle with agility to handle any terrain along with a soldier.

Program to Completion:

- The basic research program in artificial intelligence will continue to explore perception and cognition problems whose solution could revolutionize DoD systems in the future.
- Work will continue in cooperative problem solving, reasoning with uncertainty, image understanding, knowledge-based system tool development, and natural language because of their overwhelming importance in solving critical military problems.
- Research in planning and user modeling will be exploited in command and control systems.
- The new architectures from Strategic Computing (ST-10) for advanced distributed systems will be used to increase functionality and performance.
- The advanced robotic manipulator will be demonstrated.
- Micro electro-mechanical actuators will be demonstrated.
- The usefulness and intelligence of robotic systems will be increased

Program Element: #0602301E
Title: Strategic Technology
Project Number: ST-11
Budget Activity: 1. Technology Base
Project Title: Intelligent Systems

by developing improved means for their programming and control.
- An agile and highly mobile vehicle will be constructed.

D. WORK PERFORMED BY: The major performers are Stanford University, Stanford, California; Carnegie-Mellon University, Pittsburgh, Pennsylvania; University of Utah, Salt Lake City, Utah; Ohio State University, Columbus, Ohio; and FMC Corporation, Minneapolis, Minnesota.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

Change	Schedule	Schedule Change	Budget Year Cost
Cost	Demonstrate the generation of vision algorithms within the SOAR paradigm.	cancel	-1,100
Cost	Demonstrate experimental parallel versions of knowledge-based systems.	cancel	-1,500

NARRATIVE DESCRIPTION OF CHANGES

COST CHANGES: Budgeting reductions force project changes and cancellation of some FY 1989 demonstrations. The advanced robotic manipulator (ARM) and dynamically balanced vehicle efforts have been added.

F. PROGRAM DOCUMENTATION: Not Applicable.

G. MILESTONE SCHEDULE:

Plan	Milestones
Sep 1988	Demonstrate a mobile robot capable of estimating the motion of targets from noisy data.
Sep 1988	Demonstrate a prototype adaptive automated problem solver using case-based reasoning.
Sep 1988	Demonstrate formal reasoning support for a verifiable subset of Ada.
Sep 1989	Demonstrate the major new high performance image analysis systems exploit parallel hardware.
Sep 1989	Demonstrate enhanced capabilities of replanning explanations to produce clarifying information.
Sep 1990	Demonstrate advanced robotic manipulator (ARM)
Jun 1993	Construct dynamically balanced, agile, all-terrain vehicle.

H. RELATED ACTIVITIES:

- Program Element #0602301E, Strategic Technology is based upon machine intelligence research performed under the Intelligent Systems Program.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E Title: Strategic Technology
Project Number: ST-12 Budget Activity: 1. Technology Base
Project Title: Advanced Quantum Electro-Optics

A. RESOURCES: ($ in thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Advanced Quantum Electro-Optics	9,740	23,606	17,147	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES:

The objective of the Advanced Quantum Electro-Optics project is to develop those optical technologies that make possible a wide range of new military capabilities. This project, started in late FY85, focuses on developing advanced materials and techniques for increasing the resolution of optical systems and increasing the temporal resolution of optical and microwave systems. This project includes work on non-linear optics for atmospheric correction, active and passive systems for imaging and target detection and picosecond laser technology for precision measurements of material processes and ultrafast optoelectronics. Beginning in FY88 materials approaches and device concepts will be pursued to protect sensors and eyes to the threat of battlefield lasers.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- New non-linear optics materials were developed for efficient harmonic conversion to generate new laser wavelengths.

- Better understanding was achieved of the capabilities and limitations of the four-wave-mixing technique.

FY 1988 Planned Program:

- For the next several years, this project will focus on the development of non-linear optics technology and GaAs technology.

- Work will continue on developing crystalline materials for efficient harmonic conversion of laser output.

- New materials for four-wave mixing phase conjugation techniques to relax optical and mechanical tolerances in larger system design will be developed. Improvements in laser operational reliability and compactness will be made. Laser brightness improvement will be extended to high output energies.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: *0602301E Title: Strategic Technology
Project Number: ST-12 Budget Activity: 1. Technology Base
Project Title: Advanced Quantum Electro-Optics

- Relax thermal stress in gallium arsenide (GaAs) crystal growth through development and implementation of hydrodynamic models and precise digital control electronics.

- Apply chemical vapor deposition (CVD) technology to sealing of packaged GaAs chips to remove need for first level hermetically sealed packages.

- Selection of contractors has begun in the program to provide protection for sensors and eyes. This program will provide the technology base in advanced non-linear materials and devices for the Service sensor programs and will attempt to provide realistic protection against future laser threats.

FY 1989 Planned Program:

- A series of field experiments will be conducted to evaluate the performance techniques for the first time.

- The high resolution imaging program will be terminated pending re-evaluation based on the results of the FY 1988 program.

- A variety of non-linear materials and device development approaches will be underway, for eventual application in protecting eyes and sensors against modern battlefield laser weapons. Realistic testing of some initial protection schemes will take place in battlefield simulations which employ "laser-like" threats.

- Program compound semiconductor crystal growth control systems to implement complete boule growth without human intervention.

- Through-level, conformal CBD coatings of leaded GaAs chips subjected to salt spray and autoclave tests.

Program to Completion:

- This is a continuing effort. Methods will have been developed using advanced non-linear materials and devices to protect eyes and sensors against battlefield laser threats. These technologies will then be transitioned to the Services for further development.

- Document software for automatic crystal growth of low stress, low dislocation gallium arsenide.

- Apply conformal, hermetically sealing CVD coatings to memory modules populated with 16K and 64K memory chips then evaluate advantages obtained in density and sub-system performance.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E Title: Strategic Technology
Project Number: ST-12 Budget Activity: 1. Technology Base
Project Title: Advanced Quantum Electro-Optics

D. WORK PERFORMED BY: The major performers are Lawrence Livermore National Laboratory, Livermore, CA; MIT/Lincoln Laboratory, MA; Dow Corning. Midland, MI; Boeing Aerospace, Seattle, WA; Rockwell Science Center, Thousand Oaks, CA.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

Change	Schedule	Schedule Change	Budget Year Cost
Cost	Proof-of-principle focal-plane imaging experiments	Dropped	-$2,150
Cost	Field demonstrations of high resolution imaging capability	Dropped	-$1,000
Cost	Classified Program deleted from project	Dropped	-$8,000
Cost	Laser-hardened reduced bandwidth thermal imaging sensor	Dropped	-$2,000
Cost	Advanced, laser hardened sensor design study	Delayed	-$1,000
Cost	Advanced, Mid-IR laser technology	Delayed	-$2,000

NARRATIVE DESCRIPTION OF CHANGES

Cost Changes: Because of budget constraints the high resolution imaging program is being scaled back and will be re-evaluated in FY88.

F. PROGRAM DOCUMENTATION: Not applicable.

G. MILESTONE SCHEDULE:

Plan	Milestone
Sep 1988	Complete re-evaluation of high resolution imaging program.
Mar 1989	Complete design, fabrication and test of initial single plate laser.
Mar 1990	Complete fabrication and evaluation of anti-laser personnel protection goggle.

H. RELATED ACTIVITIES: None.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARIES

Program Element: 0602301E Title: Strategic Technology
Project Number: ST-13 Budget Activity: 1. Technology Base
Project Title: Broad Area Search & Surveillance

A. RESOURCES: ($ in thousands)

Project Number	Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
ST-13	Broad Area Search & Surveillance	$6,500	$5,402	$10,681	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES:
This element subsumes and rescopes the Strategic Air and Cruise Missile (SACM) Program Element. Its purpose is to develop and demonstrate technology for detection of targets in a high signal to clutter environment when very large tracks of airspace or ground are involved. This includes two major missions in particular: surveillance of strategic airspace for advanced airbreathing threats such as cruise missiles, and search of enemy territory for targets with strategic or intelligence value. There are three major program activities in this project: Multi-Sensor Fusion for Air Vehicle Detection, Hybrid Bi-Static Radar, and Procensor.

The Fusion program is developing technology to combine data from qualitatively different sensors to achieve a reduction in the number of false tracks a system will pass when attempting to find small targets such as cruise missiles in large volumes of airspace.

The Hybrid Bi-Static Radar program is attempting to develop technology to exploit the enhanced radar signature and decreased systems vulnerability which are expected when the radar platform and receiver are not colocated. It envisions a space-based transmitter working with high altitude RPVs, aircraft, ground or space based receivers.

Procensor is a sensor-processor system which will enable the search for generic targets through examination of image information.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- Fusion: Data collection exercise collected simultaneous pulsed doppler, infrared, synthetic aperture radar and ESM and data from airborne platforms against 4 different airborne targets over three distinct environments.

- Hybrid Bi-Static Radar: Signatures of several different targets were taken at bistatic angles. Results support the usefulness of bi-static phenomenology.

Program Element: 0602301E Title: Strategic Technology
Project Number: ST-13 Budget Activity: 1. Technology Base
Project Title: Broad Area Search & Surveillance

- Procensor: A processing paradigm was developed which will allow search for generic targets.

FY 1988 Planned Program:

- Fusion: The data collected last fiscal year will be analyzed and fusion approaches demonstrated against it.

- Hybrid Bi-Static Radar: Continued measurement of bi-static signature and clutter data. Initial system definition.

- Procensor: Development of algorithms to be implemented within new paradigm. Specification of device technology.

FY 1989 Planned Program:

- Fusion: Continued development, refinement and extension of fusion algorithms. Supplementary data collection. System and sensor architecture planning.

- Hybrid Bi-Static Radar: pre-prototyping system demonstration and prototype planning.

- Procensor: Algorithms downselection and refinement. Device technology development. Concept of operation studies.

Program to Completion:

- Fusion: Design, construction and demonstration of a prototype fusion systems. (completion 1992)

- Hybrid Bi-Static Radar: Prototype construction decision (1989)

- Procensor: Laboratory Brassboards (completion 1991). Field Demonstration (completion 1993).

D. WORK PERFORMED BY: Environmental Research Institute of Michigan, Ann Arbor, MI; Westinghouse, Baltimore, MD; Decision Sciences Applications, Arlington, VA; Lockheed Missiles and Space Company, Sunnyvale, CA; Institute for Defense Analyses, Arlington, VA.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARIES

Program Element: 0602301E Title: Strategic Technology
Project Number: ST-13 Budget Activity: 1. Technology Base
Project Title: Broad Area Search & Surveillance

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

Change	Schedule	Schedule Changes	Budget Year Cost
Cost	N/A	N/A	$-1.994

NARRATIVE DESCRIPTION OF CHANGES

This decrease is due to an internal budget reduction. Less compelling technologies and some peripheral studies have been dropped. The effect of the decrease is to have a less comprehensive approach to strategic airspace surveillance.

F. PROGRAM DOCUMENTATION: Not Applicable.

G. MILESTONE SCHEDULE:

Plan	Milestones
Fusion:	
Dec 88	Select baseline algorithmic approaches
June 89	Establish applicability of approach to generalized environments.
Sept 89	Data Collection
Jan 90	System Preliminary Design
Sept 91	System Delivery
Hybrid Bi-Static Radar:	
Aug 88	Complete preliminary target RCS measurement
Sept 88	Complete clutter measurements
Apr 89	Complete system/technology roadmap
May 89	Complete real target measurement
June 89	System prototyping decision
Procensor:	
Dec 88	Concept of operations study complete
Mar 89	Baseline algorithms selected
Sept 89	Baseline device technology selected
Sept 90	Test plan and demonstration design review
Mar 91	Demonstration system ready

H. RELATED ACTIVITIES: No formal agreements are in existence. The technical relationships are as follows:
- with the Air Defense Initiative (ADI): broad area surveillance aspects of this program provide the high risk, long lead follow on to ADI.

Program Element: 0602301E Title: Strategic Technology
Project Number: ST-13 Budget Activity: 1. Technology Base
Project Title: Broad Area Search & Surveillance

- with Conventional Defense Initiative (CDI): broad area search is an enabling capability for many conventional defense problems. This element potentially provides a high risk, high payoff solution to this problem.

I. OTHER APPROPRIATED FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Title: Tactical Technology
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number	Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
TT-03	Naval Warfare	16,477	31,192	24,900	Continuing
TT-04	Armored Warfare Technology	40,427	31,203	32,529	Continuing
TT-05	Target Acquisition and Weapons Technology	28,381	41,950	48,692	Continuing
TT-06	Tactical Directed Energy Technology	6,320	10,750	10,000	Continuing
*TOTAL FOR PROGRAM ELEMENT		96,307	116,245	116,871	Continuing

*Totals include classified projects not identified herein.

B. BRIEF DESCRIPTION OF ELEMENT: This program element is dedicated to the advancement of research and development of concepts and technologies directed toward the development of the next generation tactical systems. The goal is to advance non-nuclear, tactical, combat capabilities to counter the expanding tactical threat. The major development objectives are: (1) to improve target acquisition and weapons technology; (2) to advance armor/anti-armor technology; and (3) to enhance ocean surveillance and anti-submarine warfare targeting and control technolgies.

C. PROGRAM ACCOMPLISHMENTS AND PLANS: Accomplishments and plans for this Program Element are discussed in the individual project descriptions.

D. WORK PERFORMED BY: This is discussed in the individual project descriptions.

E. RELATED ACTIVITIES: This is discussed in the individual project descriptions.

F. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
Project Number: TT-03
Project Title: Naval Warfare

Title: Tactical Technology
Budget Activity: 1. Technology Base

A. Resources: ($ in Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Naval Warfare	16,477	25,855	24,900	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

The objective of the Naval Warfare project is to investigate new technologies and system concepts that would significantly enhance the maintenance of effective surveillance, targeting, and control of surface and subsurface ocean areas. The project emphasizes the performance of key experiments validating critical technology elements of system concepts prior to Navy transition. Major initiatives currently being planned include (1) Integrated Acoustic ASW Technology, an umbrella program incorporating a variety of tasks in acoustic sensors and systems, including Advanced Conformal Submarine Acoustic Sonar (ACSAS), to develop a new high gain submarine sonar designed into a ship's hull using advanced structural acoustic techniques; (2) Integrated Nonacoustic Antisubmarine Warfare (INAASW); (3) Oxygen Extraction, an effort to develop technology to extract dissolved oxygen from sea water and air for underwater power and propulsion, submarine life support, chemical warfare lifesupport isolation and medical oxygen; and (4) New initiatives, such as the Mine Countermeasures (MCM) program designed to develop technologies to detect and classify mines, and use of high-altitude balloons to support over-the-horizon communications.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

Integrated Acoustic Anti-Submarine Warfare (ASW) Technology:

- Completed plan for Low Frequency Acoustic Sensor Program Seismic ARIADNE; Started work on ocean bottom seismometers and borehole instruments package.

Integrated Non-Acoustic ASW Technology:

- Conducted joint UK/US radar ocean imaging experiment.
- Started theoretical studies in surface wave phenomena and work on advanced radar systems.
- Began experimental program (JADE).
- Examined conceptual system design for use of RPVs.

Program Element: #0602702E
Project Number: TT-03
Project Title: Naval Warfare

Title: Tactical Technology
Budget Activity: 1. Technology Base

Oxygen Extraction:

- Brought efficiency to point that enables underwater vehicle to operate using only oxygen extracted from sea water and stored fuel.
- Designed simple demonstration vehicle.

New Initiatives:

- Demonstrated ability to locate underwater mines.
- Started program to test feasibility of shallow mine detection.
- Started program (ZEPHYR) to demonstrate high altitude, balloon-borne communications transponder.

FY 1988 Planned Program:

Integrated Acoustic ASW Technology:

- Conducting experiments to explore newly emerging technologies.
- Investigating signal processing concepts.
- Performing final check on quarter-scale model of ACSAS and performing deep release bouyant pop-up test on model.
- Preparing seismic sensors and data recording equipment, and optimizing test plans for Seismic ARIADNE experiments.

Integrated Non-Acoustic ASW Technology:

- Conducting ocean experiments.
- Exploring innovative nonacoustic technologies.

Oxygen Extraction (Artificial Gill):

- Conducting laboratory demonstration of complete technology for underwater vehicle power train.
- Starting extended life testing of artificial gill; Planning second-generation, application-oriented demonstrations.

New Initiatives:

- Demonstrating intra-battle-group over-the-horizon communications fleet exercise of high altitude transponder (ZEPHYR).
- Fabricating and preparing to test the world's first mine-hunting laser radar.

FY 1989 Planned Program:

Integrated Acoustic ASW:

- Demonstrate acoustic surveillance work station, and test with Navy acoustic arrays.

Program Element: #0602702E Title: Tactical Technology
Project Number: TT-03 Budget Activity: 1. Technology Base
Project Title: Naval Warfare

- Carry out final round of tests, and transition to full Navy sponsorship.
- Begin sea tests of broadband seismic sensors.

Integrated Non-acoustic ASW:

- Conduct major experiments and analyze earlier results.
- Conduct detection tests (JADE).

Oxygen Extraction (Artificial Gill):

- Program will terminate due to cost reductions.

Program to Completion:

This is a continuing program.
Artificial Gill program joint DARPA and Army/Navy demonstrations will be completed in FY 1990.
JADE program will transition to the Navy in FY 1991.
Seismic ARIADNE will transition to the Navy in FY 1990.
High altitude balloon borne transponder will transition to the Navy in FY 1990.

D. WORK PERFORMED BY:

Approximately 80% of the work of the Naval Warfare project is carried out by industry and 20% by DoD in-house agencies. Industrial contractors involved in research programs under this project are: Bolt, Beranek and Newman, Inc., Arlington, Virginia and Cambridge, Massachusetts; Orincon Corporation, LaJolla, California; Pacific-Sierra Corporation, Los Angeles, California; Raytheon Company, Portsmouth, Rhode Island; Applied Physics Laboratory, and Johns Hopkins University, Columbia, Maryland.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

Impact of Changes

Change	Schedule	Schedule Change	Budget Year Cost
cost	At-sea demo of use of artificial gill in underwater vehicle	cancelled	- $3,000
cost	New initiatives in acoustic detection	cancelled	- $3,000

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
Project Number: TT-03
Project Title: Naval Warfare

Title: Tactical Technology
Budget Activity: 1. Technology Base

NARRATIVE DESCRIPTION OF CHANGES

At-sea demo of use of artificial gill in underwater vehicle and new initiatives detection was cancelled.

F. PROGRAM DOCUMENTATION: Not Applicable.

G. MILESTONE SCHEDULE:

Plan	Milestones
Integrated Acoustic Anti-Submarine Warfare:	
Apr 89	Surveillance work station demonstration
Advanced Conformal Submarine Acoustic Sonar (ACSAS):	
May 88	Far-Field ensonification tests
Nov 88	Hydrodynamic Noise tests
Sep 89	Transition to Navy
Seismic ARIADNE:	
Aug 89	Begin sea tests
May 90	Complete sea tests
Sep 90	Transition to Navy

H. RELATED ACTIVITIES: Specific Naval Warfare project coordination mechanisms are as follows: Seismic ARIADNE and JADE are joint ventures by DARPA and Navy OP-21; ACSAS program is a joint venture by DARPA, Office of Naval Research, and Office of Chief of Naval Operations and is governed by existing Memorandum of Agreement (MOA). Overall coordination of effort maintained with Under Secretary of Defense for Acquisition (USD-A) and Director of Defense Research and Engineering (DDR&E).

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E Title: Tactical Technology
Project Number: TT-04 Budget Activity: 1. Technology Base
Project Title: Armored Warfare Technology

A. RESOURCES: ($ in Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Armored Warfare Technology	40,427	33,555	28,694	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

In late 1985 the Defense Science Board reported that Soviet Armor and Anti-Armor had improved dramatically. Their conclusion was that we are behind and falling further behind in this area.

Requirements driven by this situation are Free World improvements in both light and heavy armor to provide significantly improved protection at reduced weight. In addition, kinetic and chemical energy warheads that will defeat current and planned Soviet armors must be developed rapidly. In response to these requirements, the Secretary of Defense tasked the Defense Advanced Research Projects Agency to lead a joint advanced research program to enhance the state-of-the-art in blue protection and penetration technology, and lay the basis for a competitive modernization rate.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- Low cost, high ballistic performance ceramic armor material demonstrated.
- Initial test facilitization for Los Alamos National Laboratory shoot-off evaluation completed.
- Electromagnetic launch of projectiles and completion of additional hypervelocity launch facility.

FY 1988 Planned Program:

- Begin ballistic analysis of program products at the Advanced Technology Assessment Center at Los Alamos.
- Identify technology candidates for near term applications and put them on a "fast track" for Service transition.
- Enhance technology base in areas such as design code development and improved materials characterization and processing techniques to support the modernization process.

AMENDED BY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E Title: Tactical Technology
Project Number: TT-04 Budget Activity: 1. Technology Base
Project Title: Armored Warfare Technology

FY 1989 Planned Program:

- Continue promising tech base efforts to support competitive modernization rate.

Program to Completion:

- Defense Advanced Research Projects Agency-Army-US Marine Corps Memorandum of Understanding is for five years, ending in FY90.
- Certain program technologies will be "harvested" as soon as FY88-89. However, due to the open-ended nature of the threat, this is a continuing program.

D. WORK PERFORMED BY: The major performers are Los Alamos National Laboratory, Los Alamos, New Mexico; Battelle Memorial Institute, Washington, DC; Lawrence Livermore National Laboratory, Livermore, California; FMC, San Jose, California; and University of Texas, Austin, Texas.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

CHANGE	Schedule	Schedule Change	Budget Year Cost
Cost	Planned system demonstration program for Electromagnetic Gun	deleted	- $14,000

NARRATIVE DESCRIPTION OF CHANGES

Electromagnetic Gun Demonstration Program reduced, eliminating funding for planned system demonstration program.

F. PROGRAM DOCUMENTATION: Not applicable.

AMENDED BY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E Title: Tactical Technology
Project Number: TT-04 Budget Activity: 1. Technology Base
Project Title: Armored Warfare Technology

G. MILESTONE SCHEDULE:

Plan	Milestones
Armor/Anti-Armor	
Contin-uing	Identify mechanisms and phenomenology of advanced armor and penetration; high strain rate materials characterizion, develop advanced passive and active armor techniques.
May 1989	Test advanced kinetic energy projectile
Electromagnetic Gun	
Dec 1987	Single shot 9 megajoule electromagnetic (EM) gun tests began
Dec 1989	Transition to Army

H. RELATED PROGRAMS:

Program Element 0603226E/Project EE-21 Armor/Anti-Armor Advanced Development

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
Project Number: TT-05
Project Title: Target Acquisition and Weapons Technology

Title: Tactical Technology
Budget Activity: 1. Technology Base

A. RESOURCES ($ in Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Tactical Technology	32,524	41,950	48,692	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This technology base concentrates on developing sensors and signal processors which exploit the United States leadership in military sensors, computer technology, and airframe design to provide a new capability by amplifying the effectiveness of conventional weapons through markedly increasing their ability to accurately acquire, penetrate and destroy enemy targets. The resultant system capability improvement will tend to lessen our dependence on strategic weapons by sensing the location of more and deeper targets, selecting targets of higher value, and more accurately directing and guiding weapons to those targets in a survivable manner.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

This project is composed of several coordinated and related technology efforts comprised of sensor developments in different electro-magnetic spectrums, signal processing of data from these sensors and demonstrations of the utility of the technology to facilitate transition for exploitation by the Services.

FY 1987 Program:

- Ground based tests of an Remotely Piloted Vehicle Surveillance Radar
- Signatures collected on surface to surface missiles for an Autonomous Infrared Sensor
- Images collected from a high sensitivity array of Uncooled Infrared Sensors
- Swimmer Delivery Vehicle Trainer transitioned to the Navy by the Small Unit Technology Program
- Air Land Battlefield Management interfaces design and construction
- Infrared Binary Optics used in conducting laboratory demonstration of low-cost infrared imager
- Smart Weapons Program transitioned to Phase II by downselecting to two contractor teams

FY 1988 Planned Program:

- Program components demonstrated in the European theater (Tactical Use of National Means Technology Program)

Program Element: #0602702E Title: Tactical Technology
Project Number: TT-05 Budget Activity: 1. Technology Base
Project Title: Target Acquisition and Weapons Technology

- Captive flight testing of the Surveillance Radar for the Remotely Piloted Vehicle
- Image metrics and algorithm evaluation techniques established for the Autonomous Infrared Sensor
- High density Uncooled Infrared Sensor Arrays imaging demonstration
- Airborne Millimeter Wave Autonomous Sensor testbed radar completed; data collection begun
- Transfer of Small Unit Technology Planning Aid to Special Operations Forces
- Flight tests of Advanced Technology Tactical Transport
- Air Land Battlefield Management demonstration of TEMPLAR/Air Land Battlefield Management in the Continental United States
- Infrared Binary Optics Program developments in Long Wave Infrared Imager and other applications

FY 1989 Planned Program:

- Evaluation of algorithms by the Tactical Use of National Means Program
- Signature collection completed for the Autonomous Infrared Sensor Program: techniques for evaluation and metrics transitioned to the Services
- Evaluation of automatic target recognition techniques and advanced algorithm research by the Millimeter Wave Autonomous Sensor Program
- Interface demonstrated in the European Command by Air Land Battlefield Management
- Delivery of low-cost infrared optics and other applications (Infrared Binary Optics Program)
- Transition Uncooled Sensor Arrays to Service Seeker Development

Program to Completion:

- Transition Binary Optics Program to specific Service applications
- Publish results of Autononous Infrared Program
- Initiate development for imaging two-color IR seeker for submunitions

This is a continuing program.

D. WORK PERFORMED BY: Honeywell, Boston, MA; Martin Marietta, Orlando, FL; Lincoln Laboratories; Texas Instruments, Dallas, TX.

AMENDED FY 1988/1989 BIENNIAL BUDGET.
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E Title: Tactical Technology
Project Number: TT-05 Budget Activity: 1. Technology Base
Project Title: Target Acquisition and Weapons Technology

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

CHANGE	Schedule	Schedule Change	Budget Year Cost
Cost	Tests	Mar 1989	+ $ 4,400

NARRATIVE DESCRIPTION OF CHANGE

Not available.

F. Program Documentation: Not applicable.

G. MILESTONE SCHEDULE:

Plan	Milestones
Tactical Use of National Technical Means Program	
Aug 1988	Demonstrate components in Europe
Jun 1989	Evaluate tracking algorithms
Sep 1989	Demonstrate integrated system test bed
Surveillance Radar Program	
Dec 1987	Free flight test of the RPV radar
Autonomous Infrared Sensor Program	
Sep 1988	Establish image metrics and algorithm evaluation
Sep 1989	Signature collection completed
Sep 1989	Metrics, evaluation techniques transitioned to the Services
Uncooled Infrared Sensor Arrays Program	
Jun 1989	Demonstrate high density imaging and transition to the Services (U)
Millimeter Wave Autonomous Sensor Program	
Dec 1987	Airborne Millimeter Wave testbed radar developed
Feb 1990	Complete data collection, algorithm research
Sep 1990	Automatic target recognition techniques developed and evaluated
Jun 1991	Seeker designs evaluated, delivered to Services
Small Unit Technology Program	
Jan 1988	First flight of Advanced Technology Tactical Transport
Sep 1988	Transfer Small Unit Planning Aid to Special Operations Forces
Tactical Expert Mission Planner (TEMPLAR)/Air Land Battlefield Management (ALBM)	
Sep 1988	TEMPLAR/ALBM interface demonstrated in the Continental United States
Sep 1989	Interface demonstrated in the European Command
Infrared Binary Optics Program	
Sep 1988	Demonstrate Low Cost IR Telescope

H. RELATED PROGRAMS: None.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988-1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E Title: Tactical Technology
Project Number: TT-06 Budget Activity: 1. Technology Base
Project Title: Tactical Directed Energy Technology

A. RESOURCES: ($ in thousands)

Project Number	Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
TT-06	Tactical Directed Energy Technology	6,320	10,750	10,000	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

The objective of the Tactical Directed Energy Technology Project is to develop moderate-power, efficient, high-brightness lasers and high-power microwave source and antenna technology for a broad spectrum of tactical, military applications. This project includes efforts focused on the development of (1) new compact, efficient, frequency-agile solid state lasers and (2) tunable high-power microwave source/antenna development. Some efforts of the Strategic Defense Initiative Organization (SDIO) are complementary; however much of their work is not appropriate to tactical applications since (1) the laser brightness required for tactical applications is about six to eight orders of magnitude less than that required for ballistic missile defense applications and (2) scaling down the SDIO laser technology is an inappropriate and expensive alternative to the approaches described herein to achieve the compactness and frequency agility required for conventional tactical applications.

The 1987 Defense Science Board Task Force on Tactical Directed Energy Weapons (DEW), reaffirmed the importance of the Tactical Directed Energy project started by DARPA in FY 1985. The DARPA project focuses on the conventional needs of the tactical battlefield. The technologies being developed will enable the Services to develop tactical directed energy weapon systems (TDEWS) that are effective. These systems will be compatible with friendly forces (no fratricide) and will be low cost so that many TDEWS could be procured. The DARPA investment in TDEW technology is a springboard for potential joint DARPA/Service TDEWS prototype development.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- New research was started to investigate compact arrangement and novel design of laser activated silicon switch transmission lines to generate microwave energy through digital synthesis.

AMENDED FY 1988-1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E Title: Tactical Technology
Project Number: TT-06 Budget Activity: 1. Technology Base
Project Title: Tactical Directed Energy Technology

FY 1988 Planned Program:

- In FY 1988, the medium power solid state laser technology base program will continue. This program will demonstrate high efficiency, high pulse repetition rate laser operation using both Nd:Glass and crystalline laser media as well as wavelength conversion and good beam quality.

- A number of brassboards will be produced to enable the Services to explore the operational utility of these devices, especially in low intensity conflicts.

FY 1989 Planned Program:

- In FY 1989, the medium power solid state laser technology base program will be completed.

- The development of advanced engineering models will continue.

- The design of a transportable high power microwave source and antenna brassboard for advanced surveillance and/or anti-smart weapon (e.g., terminally guided submunition) applications will be started.

- Competitive designs of advanced engineering model incorporating better system concept ideas, breakthroughs in solid state laser technology and advances in phase conjugation technology, all packaged to fit a high value weapon platform, to enhance the platform's fire power will be started.

Program to Completion: This is a continuing effort. The advanced engineering models will be completed and evaluated, and decisions made for future demonstration and prototype efforts as well as for engineering development by the Services.

D. WORK PERFORMED BY: At present, top performers are Lawrence Livermore National Laboratory, Livermore, California; Los Alamos National Laboratory, Los Alamos, New Mexico; Hughes Aircraft Co., El Segundo, California; Sanders Associates, Nashua, New Hampshire; and Physics International, Oakland, California.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

Change	Schedule	Schedule Change	Budget Year Cost
Cost	Same performance goals as originally planned.	Milestones delayed about one year.	$4,500

AMENDED FY 1988-1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E Title: Tactical Technology
Project Number: TT-06 Budget Activity: 1. Technology Base
Project Title: Tactical Directed Energy Technology

NARRATIVE DESCRIPTION OF CHANGES

Budget reductions and other undistributed cuts reduced the funds programmed for tactical directed energy technology project by $4.5 million in FY 1989.

F. PROGRAM DOCUMENTATION: Not applicable.

G. MILESTONE SCHEDULE:

Plan	Milestones
Sep 1992	Development of advanced engineering models.

H. RELATED ACTIVITIES: Plans for the new Tactical Directed Energy Technology project are coordinated through frequent technical interchange meetings with representatives from the three Services' tactical directed energy programs. Technology developments under the Strategic Defense Initiative Organization are periodically reviewed to identify possible opportunities for exploitation. DARPA is also an active participant of the US-UK Information Exchange program on laser weapon technology and effects.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988-1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602707E

Title: Particle Beam Technology
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in thousands)

Project Number	Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
PB-01	Particle Beam Technology	14,500	$14,000	$14,000	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

The major objective of this effort is to demonstrate the scientific feasibility of developing defensive weapons using high power electron beams. Such weapons would have the advantages of near speed-of-light delivery, very rapid retargeting, and deep target penetration resulting in catastrophic kill of high performance targets from a variety of kill mechanisms. Potential applications include all-weather ship defense against advanced, highly mobile, non-nuclear missiles, defense of mobile ground vehicles against sub-munitions and land mines, and defense of fixed, hard-sites (silos).

Since the initiation of the program in 1978 the major R&D thrust has been the demonstration of stable, predictable, propagation of a relativistic electron beam within the atmosphere. To this end, DARPA developed and constructed the Advanced Test Accelerator (ATA) at the Lawrence Livermore National Laboratory as the program's major experimental facility.

In FY 1985 certain elements of the charged particle beam program directed toward research of space-based electron beam weapon concepts were transferred to the new Strategic Defense Initiative Organization. In addition, the ATA has become the primary SDI facility for development of the Induction Free Electron Laser (IFEL).

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- The first open-air propagation experiments were conducted at the Advanced Test Accelerator (ATA).

- Stable propagation in the open air was observed even during adverse weather conditions including rain and fog.

- The Spiral Line Induction Accelerator (SLIA) emerged as a the lowest risk approach to the configuration of a near term weapon.

AMENDED FY 1986-1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602707E

Title: Particle Beam Technology
Budget Activity: 1. Technology Base

FY 1988 Planned Program:

- The ATA will begin a series of upgrade modifications to enable high repetition rate, multiple pulse operation in anticipation of extended range, atmospheric propagation experiments.

- The RADLAC II accelerator at Sandia National Laboratory will be modified for very high current operation. High current propagation experiments will be conducted.

- Tracking experiments will continue to characterize the force and the influences of beam current, atmospheric water vapor, and background ionization.

FY 1989 Planned Program:

- Multiple pulse experiments at reduced pressure will be conducted on ATA to verify theoretical predictions of extended range propagation.

- Initial tests of the SLIA accelerator technology will verify the feasibility of producing accelerators compact enough for use as weapons.

- An experimental program will be initiated to investigate the Propagation of Ultra-Relativistic Electrons (PURE) through the atmosphere as a new and very promising propagation mode.

- First experiments will be conducted to demonstrate the Spiral Line Induction Accelerator (SLIA) technology for producing very small, lightweight electron accelerators.

Program to Completion:

- FY 1990: Two-pulse propagation experiments will be conducted.

- FY 1991: An integrated demonstration of stable, many pulse propagation will be performed.

D. WORK PERFORMED BY: The major participants are: Lawrence Livermore National Laboratory, Livermore, California; Sandia National Laboratories, Albuquerque, New Mexico; Naval Research Laboratory, Washington, D.C.; Science Applications International Corporation, Palo Alto, California; and McDonnell Douglas Research Labs, St. Louis, Missouri.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY: No changes.

F. PROGRAM DOCUMENTATION: Not Applicable.

AMENDED FY 1988-1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602707E

Title: Particle Beam Technology
Budget Activity: 1. Technology Base

G. MILESTONE SCHEDULE:

Plan	Milestones
Sep 1988	Demonstration of high current lead pulse stability at RADLAC II
Jul 1989	Initial demonstration of the Spiral Line Induction Accelerator
Mar 1990	Two Pulse Range extension experiment
Jun 1991	Demonstration of PURE (Propagation of Ultra-Relativistic Electrons) mode

H. RELATED ACTIVITIES: In FY 1980 the Under Secretary of Defense for Research and Engineering approved the Particle Beam Technology Program which, beginning in FY 1981, consolidated the DoD particle beam efforts under the overall technical direction of DARPA. Under this plan, DARPA assumed responsibility for both charged and neutral particle beam feasibility experiments. The Military Departments were responsible for advancing those technologies, which are essential in order to rapidly develop particle beam weapons once they are proven feasible. In FY 1983, the transition to Army began for the neutral particle beam program. This work is presently being continued under the sponsorship of the Strategic Defense Initiative Organization (SDIO).

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E Title: Integrated Command and Control Technology

Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number	Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
IC-01	Distributed Information Systems	19,510	14,843	14,540	Continuing
IC-02	Advanced Command, Control and Communications Technology	18,363	17,157	18,820	Continuing
TOTAL FOR PROGRAM ELEMENT		37,873	32,000	33,360	Continuing

B. BRIEF DESCRIPTION OF ELEMENT: The objectives are to develop and demonstrate technology under Distributed Information Systems for building systems that can fulfill DoD needs for information processing in DoD C3 applications. In Advanced Command, Control and Communication Technology, research is aimed at the development of survivable, intelligent networks, utilizing advanced architectures and devices for controlling large-scale, high-performance secure communications networks for world wide command and control.

C. PROGRAM ACCOMPLISHMENTS AND PLANS: Accomplishments and Plans for this Program Element are discussed in the individual project descriptions.

D. WORK PERFORMED BY: This is discussed in the individual project descriptions.

E. RELATED ACTIVITIES: This is discussed in the individual project descriptions.

F. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E
Project Number: IC-01
Project Title: Distributed Information Systems

Title: Integrated Command and Control Technology
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Distributed Information Systems	19,510	14,340	14,540	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The objectives of this project are to develop and demonstrate technology for building high-performance geographically distributed information systems which can handle classified data, meet specific real-world time constraints, and be easily expanded to fulfill DoD needs for information processing in DoD command, control and communications applications. Techniques are being developed to support secure distributed processing among computers on different networks, including mechanisms to manage the networks and programming environments. This will provide the kind of resource sharing and interoperability required to support the insertion of Strategic Computing technologies (PE 0602301E, Project ST-10) into the distributed systems technology base.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- Techniques developed to support a very large number of nodes on the Internet as well as to move large amounts of priority ordered data, and to interoperate with commercial systems. Development of interoperability techniques with OSI standards and NATO C3 systems were explored.
- Design and integration began on a new distributed operating system nucleus based on advanced object-oriented design techniques (MACH).
- The distributed sensor network program was completed.
- The Ft. Knox SIMNET (Simulator Networking) test site expanded to test a full battalion and a SIMNET second site at Ft. Benning was started.
- Development of an advanced prototype software design that can support an Ada environment.

FY 1988 Planned Program:

- Continuation of work to support very large networks, including OSI standards and other methods to enhance interoperability among C3 systems.
- Ada and MACH are being used to explore new methodologies for developing C3 systems, including object-based image communication techniques and techniques for managing complex, multimedia networks.
- Security requirements and architectures are being explored.
- Distributed systems technology components are being selected and adapted for use in tactical distributed C3 systems. Design and implementation is underway for a new distributed operating system based on advanced object-oriented design techniques to support interoperability among C3 systems.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E
Project Number: IC-01
Project Title: Distributed Information Systems

Title: Integrated Command and Control Technology
Budget Activity: 1. Technology Base

FY 1989 Planned Program:

- Techniques will be developed to support policy routing on the Internet as well as to move large amounts of priority ordered data, techniques for interoperability among C3 systems will be demonstrated on testbed environments, and facilities for interoperability with OSI standards will be completed.
- Ada and MACH will be used to explore new methodologies for developing C3 systems, and object-based image communication techniques will be demonstrated in a multi-media environment.
- Security requirements and architectures will be developed for Internet technology and experimental networks. End-to-end encryption devices will be installed in order to provide privacy for network data traffic.
- Distributed systems technology will continue to be explored, including demonstrations of applications on distributed C3 systems. Methods for network-based support of software systems will be developed.

Program to Completion:

- The Internet environment will become a tightly integrated network of high-performance networks. Interoperability with other protocol systems will be explored, as the Internet transitions to OSI standard protocols.
- Techniques will be developed and demonstrated for providing the required real-time data communication to support distributed command and control applications in an Internet environment, and to permit a locally specified tradeoff between transparency and autonomy in a distributed systems.
- Mechanisms will be developed which permit integrated operation of very large distributed systems with thousands of nodes, where a simple design procedure allows information support to be spread across an integrated network. Techniques which simplify, expedite and reduce the cost of software maintenance in distributed systems will be demonstrated.
- An advanced Ada environment will be developed suitable for use with a new generation of software and system tools.

D. WORK PERFORMED BY: The major performers are University of Southern California/Information Sciences Institute, Marina del Rey, California; Bolt, Beranek and Newman, Cambridge, Massachusetts; Carnegie-Mellon University, Pittsburgh, Pennsylvania; Massachusetts Institute of Technology, Cambridge, Massachusetts; and University of California Los Angeles, Los Angeles, California.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E
Title: Integrated Command and Control Technology
Project Number: IC-01
Project Title: Distributed Information Systems
Budget Activity: 1. Technology Base

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

Change	Schedule	Schedule Change	Budget Year Cost
Cost	Certify end-to-end encryption device.	Oct 1988	-240
	Demonstrate interoperability between DoD and OSI networking protocols.	Jul 1989	-1,200
	Initiate installation of privacy devices in Internet environment.	Jul 1990	-1,600

NARRATIVE DESCRIPTION OF CHANGES

COST CHANGES: Initiation of ARPANET privacy effort will be delayed until commercial development of appropriate devices occurs. Budget reductions force delays of 12 months for interoperability development and 15 months in end-to-end encryption device.

F. PROGRAM DOCUMENTATION: Not Applicable.

G. MILESTONE SCHEDULE:

Plan	Milestones
Sep 1988	Complete initial prototype of new distributed systems foundation.
Oct 1988	Certify end-to-end encryption system for use at Fort Bragg.
Jun 1989	Demonstrate distributed, large scale C3 system across the Internet.
Jul 1989	Demonstrate interoperability between DoD and OSI standard protocols.
Jul 1990	Initiate installation of privacy devices in Internet environment.

H. RELATED ACTIVITIES:

The work provides the technical base for other DARPA program areas, particularly Program Element #0602301E Strategic Technology.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0605898E Title: Management Headquarters
Budget Activity: 6. Defensewide Mission Support

A. RESOURCES: ($ in thousands)

Project Number	Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
	Management Headquarters	12,993	15,034	15,497	Continuing

B. BRIEF DESCRIPTION OF ELEMENT: This program element provides funds for payment of salaries to civilian employees and for administrative support costs of the Defense Advanced Research Projects Agency (DARPA). This funding provides for the personnel compensation and benefits for civilians assigned to DARPA as well as costs for building rent, physical and information, security, travel, supplies and equipment, communications, printing and reproductions. In addition, funds are included for reimbursing the Military Services for administrative support costs associated with contracts undertaken on the Agency's behalf.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program: Funding under this program element in FY 1987 supported management and administration for the RDT&E program assigned to DARPA. The majority of the funds were required for the pay of personnel who operate the Agency. Beginning in FY 1983, this project included funding to reimburse the various Service agents for costs associated with their administration of DARPA's contracts. These funds had been previously budgeted in the technical program elements which had funded the technology base programs.

FY 1988 Planned Program: The management and administrative support efforts for headquarters DARPA will continue at approximately the same level as FY 1987. The major increases are due to physical and information security improvements, and in personnel compensation and benefits for the fourteen additional billets associated with DARPA's expanded prototyping role and limited contracting capability.

FY 1989 Planned Program: The management and administrative support efforts for headquarters DARPA will continue at approximately the same level as in FY 1988.

Program to Completion: This is a continuing program.

D. WORK PERFORMED BY: Civilian and military personnel assigned to the Defense Advanced Research Projects Agency and by DARPA agent personnel operating within the Military Services.

E. RELATED ACTIVITIES: Not applicable.

F. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E
Project Number: IC-02
Project Title: Advanced Command, Control and Communications Technology

Title: Integrated Command and Control Technology
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Advanced Command, Control and Communications Technology	18,363	17,157	18,820	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The objectives are to develop and demonstrate integrated systems of advanced command and control technologies and transfer these to the Services and other Agencies.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- The Metal Oxide Semiconductor Implementation System (MOSIS) continued to accept and fabricate research designs; under a joint program with NSF, provided fabrication to U.S. university classes at costs appropriate to lab fees; and, enabled easy, rapid and inexpensive acquisition of electronic components.
- Initiated an object-flow approach to computer-integrated design, manufacture and test.
- The results of the Strategic C3 experiment were evaluated and documented. Experimentation with new techniques improving survivability and security began. Preliminary designs for the Multiple Satellite System were completed and requests for proposals to build a prototype system were released.
- The Army/DARPA Distributed Communication and Processing Experiment (ADDCOMPE) distributed command and control applications were evaluated and evolved in the Fort Bragg testbed.
- A protocol suite to support multimedia conferencing over the Internet was tested and used to define and test methods and tools for specifying and developing very large C3 systems by evolution and assimilation.
- An architecture and some devices for ensuring privacy of multimedia conferences in very large C3 systems were developed. Utility programs and a distributed operating system for the Internet were integrated into this testbed to investigate automated resource management, data distribution, and failure recovery for distributed command and control applications in the future.
- Initial design began on software systems to facilitate adaptive strategic mission planning, using recent advances in machine intelligence and user interface technology, and airborne link test of a survivable high bandwidth communications capability was performed.

FY 1988 Planned Program:

- MOSIS continues to provide system prototypes access to a spectrum of advanced semiconductor processes and options and other technologies such as Gallium Arsenide (GaAs) and Wafer-Scale Integration (WSI).
- A survivable, adaptable network testbed will be transitioned to the Army after the demonstration of the Automated Network Monitor (ANM) in the Fort Bragg testbed. The next phase of this effort will begin at Fort Lewis.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E
Project Number: IC-02
Project Title: Advanced Command, Control and Communications Technology

Title: Integrated Command and Control Technology
Budget Activity: 1. Technology Base

- Technology for rapid display of command and control information is being developed and integrated with multimedia conferencing.
- Development of software systems to facilitate adaptive strategic mission planning will start.
- A high-performance testbed for Internet policy routing experiments is being developed in cooperation with the other Federal agencies.
- A quick reaction design prototyping system will be installed at the FBI.

FY 1989 Planned Program:

- MOSIS will start offering prototyping services for sub-micron semiconductor technologies that will enable rapid development.
- Experimentation with techniques improving survivability and security will continue, including design evaluations for the Multiple Satellite System.
- Tactical end-to-end network security will be developed in cooperation with the National Security Agency and integrated into the tactical prototypes.
- An integrated capability for multimedia conferencing will be demonstrated in a tactical testbed, and used to develop a joint command testbed with the JCS and one or more CINC's.
- The Internet testbed will provide continually higher performance. Utility programs and distributed operating system components will be integrated into the testbed to provide automated resource management, data distribution, and failure recovery which can serve as a model for future distributed command and control systems.
- Software systems to facilitate adaptive strategic mission planning will add maturing machine intelligence and user interface technologies, including a demonstration of distributed wargaming using computer resources embedded in C3 systems.

Program to Completion:

- MOSIS will be institutionalized on a self-supporting basis.
- Computer integrated manufacturing methods will be applied to manufacturing semiconductor testbeds and extended to other technologies.
- A network management system for large scale survivable networks will be developed and evaluated.
- Command and control experiments will be conducted to exercise a rapid adaptive strategic mission planning capability.
- A balanced set of advanced C3 technologies suited for defense requirements of the 21st century will be demonstrated, evaluated, and transfered to the Services in an integrated set of multi-Service, multi-echelon testbeds for ground, air, and satellite-based employment.

D. WORK PERFORMED BY: The major performers are University of Southern California/Information Sciences Institute, Marina del Rey, California; Bolt, Beranek and Newman, Cambridge, Massachusetts; SRI International, Menlo Park, California; Hazeltine Corporation, Greenlawn, New York; and, University of California at Berkeley, Berkeley, California.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E
Title: Integrated Command and Control Technology
Project Number: IC-02
Project Title: Advanced Command, Control and Communications Technology
Budget Activity: 1. Technology Base

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

Change	Schedule	Schedule Change	Budget Year Cost
Cost	Demonstrate low-cost multi-satellite communication in the laboratory.	Dec 1988	-900K
	Demonstrate large-scale survivable network.	Mar 1989	-500K
	Airborne demonstration of the Multiple Satellite concept.	Dec 1989	-600K

NARRATIVE DESCRIPTION OF CHANGES

COST CHANGES: Demonstrations delayed six months due to funding reductions.

F. PROGRAM DOCUMENTATION: Not Applicable.

G. MILESTONE SCHEDULE:

Plan	Milestones
Sep 1988	Demonstrate low-cost multi-satellite communication in the laboratory.
Dec 1988	Large numbers of low-cost packet radios delivered to testbeds.
Mar 1989	Demonstrate large-scale survivable network.
Jun 1989	High-level design system available to government installations.
Sep 1989	Sub-micron prototyping services available through MOSIS.
Dec 1989	Airborne demonstration of Multiple Satellite concept.
Mar 1990	Transition stable portions of high-performance Internet to commercial operation.
Sep 1990	Demonstrate integrated survivable adaptive planning capability (SAPE).
Jun 1992	Demonstrate intelligent airborne platform network.

H. RELATED ACTIVITIES: None.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Title: Materials/Electronics Technology
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number	Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
MPT-01	Materials Technology	$23,237	$16,290	$13,040	Continuing
MPT-02	Electronics Technology	$7,357	$42,710	$7,500	Continuing
TOTAL FOR PROGRAM ELEMENT		$30,594	$59,000	$20,540	Continuing

B. BRIEF DESCRIPTION OF ELEMENT: Development of heterojunction technology, maskless processing for submicron structures, high efficiency compound semiconductor solarcells and low threshold semiconductor lasers. The Materials Technology Project (MPT-01) is discussed in the attached project description. The Electronics Technology Project (MPT-02) is discussed below.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- Achieved initial release of gallium arsenide process modelling software
- Realized first cascade, high efficiency solar cell
- Fabricated 4-bit, one gigasample per second analog to digital converter by tuning transistor parameters with an ion beam

FY 1988 Planned Program:

- Initiate $35 million program to support advanced compound and other semiconductor research as directed by Congress
- Use Ion beams to reduce device geometries to 500 nanometers
- Increase modulation frequency of laser diodes from 11 to 30 gigahertz
- Investigate gallium-aluminum-arsenide and silicon germanium hetero-structures for electro-optic interconnections and quantum-well devices
- Fabricate three-junction cascade solar cell

FY 1989 Planned Program:

- Demonstrate 30% efficient cascade solar cell
- Integrate ion, electron and photon beam processing into one integrated circuit fabrication module
- Initiate new optical storage technology with a goal to obtain millisecond access time to a 500 gigabytes memory system
- Initiate demonstration of a multi-sensor/processor, reconfigurable fiber optic network

Program to Completion:

- Achieve monolithic integration of electronic devices that utilize different material systems
- Develop opto-electronic electro-magnetic pulse immune processors; this is a continuing program

D. WORK PERFORMED BY: Performers include: California Institute of Technology, Pasadena, California; Texas Instruments Corporation, Dallas, Texas; The Lincoln Laboratory, Lexington, Massachusetts; and Stanford University, Palo Alto, California.

E. RELATED ACTIVITIES: Developments in electronic materials, device concepts, and processing methods are coupled to the services' programs through the DARPA agents, annual DoD-wide program reviews, and coordination through DDRE's Advisory Group on Electron Devices (AGED). These activities assure that no unnecessary duplication of effort occurs.

F. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E Title: Materials/Electronic Technology
Project Number: MPT-01 Budget Activity: 1. Technology Base
Project Title: Materials Technology

A. RESOURCES: ($ in Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Materials Technology	$23,237	$16,290	$13,040	Continuing

B. BRIEF DESCRIPTION OF ELEMENT: Development of novel materials and processing routes to demonstrate advanced composites; strong, stiff fibers; high temperature ceramic superconductors; application of artificial intelligence and sensors to materials processing; intermetallic compounds for gas turbine engines and airframes; and intelligent task automation for advanced sensory controlled robotic systems.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- Demonstrated protection of carbon-carbon composites for 10 hours at 1760°C using multilayer ceramic coatings
- Produced multifilament ceramic fibers having strengths of 300 kilopounds per square inch (Ksi) and a modulus of 32 Megapounds per square inch (Msi)
- Initiated a new program on high temperature ceramic superconductors
- Produced strong, stiff graphite/magnesium composites in tubular form with zero coefficient of expansion
- Demonstrated feasibility of assembling small complex electromechanical device automatically from a kit of parts

FY 1988 Planned Program:

- Transition the ceramic fiber program to the Air Force Wright-Aeronautical Laboratories (AFWAL), which will initiate a Manufacturing Technology Program
- Utilize intelligent processing of GaAs single crystals to provide higher yield products
- Demonstrate processing of carbon-carbon composites that gives improved properties and reproducibility
- Complete two robotic systems to demonstrate integration of robotic technology

FY 1989 Planned Program:

- Demonstrate ceramic superconductors in bulk and thin film form with high current carrying capacity
- Fabricate titanium-aluminum intermetallic compound matrix composites by rapid solidification processing

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E Title: Materials/Electronic Technology
Project Number: MPT-01 Budget Activity: 1. Technology Base
Project Title: Materials Technology

- Demonstrate improved pyrolysis capabilities through intelligent processing of carbon-carbon composites
- Evaluate high temperature (to 1400°C) ceramic composite components in gas turbine test rigs
- Transfer Intelligent Task Automation program to program element 0602301E beginning in FY 1989

Program To Completion:

- Demonstrate fiber reinforced intermetallic compounds in aircraft and engine components
- Incorporate improved sensors, artificial intelligence and expert systems applied to materials processing into DARPA's manufacturing science program

D. WORK PERFORMED BY: Major performers are: United Technologies Research Center, East Hartford, Connecticut; Dow Corning Corporation, Midland, Michigan; Martin Marietta Corporation, Baltimore, Maryland; General Electric Corporation, Schenectady, New York; and Pratt & Whitney Corporation, West Palm Beach, Florida

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

Change	Schedule	Schedule Change	Budget Year Cost ($000)
Cost	Demonstrate capability of dual alloy radial turbine (DART) rotor to withstand hot spin rig testing	Cancel delivery of DART Demonstrator	-$2,316
Cost	Evaluate advanced composite gas turbine materials	Cancel program	-$2,500
Cost	Optimization of metal matrix and carbon-carbon composites for aerospace applications	Sep 1989	-$3,660

NARRATIVE DESCRIPTION OF CHANGES

COST CHANGES: During cold spin testing of the DARPA/DART Demonstrator, extremely large vibrations were noted at 93,000 rpm. Within available funding, no suitable engineering design can be designed to rectify this

Program Element: #0602712E Title: Materials/Electronic Technology
Project Number: MPT-01 Budget Activity: 1. Technology Base
Project Title: Materials Technology

situation. This program was terminated as were plans to install the completed Demonstrator as a test rig at the Naval Air Propulsion Center. Budgeting reductions will cause a 6 month delay in the planned expansion of metal matrix and carbon-carbon composites for aerospace applications.

F. PROGRAM DOCUMENTATION: Not applicable.

G. MILESTONE SCHEDULE:

Plan	Milestones
Sep 1988	Demonstrate prototype rocket nozzle materials based on in-situ reinforced ultra-fine composites with high thermal conductivity
Sep 1988	Produce multifilament tows of ceramic fibers in sufficient quantities to demonstrate potential for scale up to a manufacturing technology program
May 1989	Demonstrated ceramic superconductors in bulk and thin film forms with high current carrying capacity
May 1989	Evaluate advanced composite gas turbine materials
Sep 1989	Fabricate intermetallic compound matrix composites and demonstrate as components for aerospace applications
Dec 1989	Demonstrate intelligent process control concept in production of gallium arsenide single crystals

H. RELATED ACTIVITIES: DARPA's research on Materials Processing Technology is coordinated within the DoD and with other federal agencies via the NSF-hosted Interagency Materials Group, OSTP's Committee on Materials, and various DDR&E sponsored topical workshops on composite materials. These activities assure that no unnecessary duplication of effort occurs.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARIES

Program Element: #0602714E Title: Nuclear Monitoring
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number	Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
NM-01	Nuclear Monitoring	$19,021	$24,330	22,600	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The Nuclear Monitoring program conducts research and development to enhance U.S. capabilities for monitoring nuclear explosions. The program provides technical information needed for developing sound national policy for negotiations on treaties limiting nuclear testing. It provides technical support for U.S. participation in the current negotiations with the Soviet Union and in treaty-related international activities. U.S. policy dictates that any agreement which places limits on nuclear testing must be effectively verifiable. This program is aimed at addressing the very difficult technical problems in establishing effective verification for existing and possible future treaties limiting nuclear testing. In particular, better technical understanding is required to assess the monitoring value of stations internal to the USSR, high frequency seismic wave propagation, accurate yield determination at all levels, and technologies which might be used in on-site monitoring. The recently begun bilateral Nuclear Testing negotiations with the Soviets in Geneva aimed at achieving effective verification of the Threshold Test Ban Treaty yield limit has clearly brought to the forefront the need for an improved technical basis for monitoring. Precedent-setting U.S./Soviet Joint Verification Experiments are being discussed and may be conducted in CY 1988. This research program will provide technical support to the planning and conduct of any cooperative experiments and will incorporate the results for an improved basis for monitoring. This research program continues to provide key technical support to U.S. efforts in the United Nations Conference on Disarmament, particularly in the development of an International Seismic Data Exchange System for global treaty monitoring. Other research efforts in this program are aimed at developing the sensors and advanced technology needed to detect the presence of nuclear materials at remote distances.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- Yield Estimation. A unified seismic method for determining the yields of large Soviet nuclear explosions with high precision was developed and applied to all the large explosions at the main Soviet nuclear weapons test site. This method offers the possibility for significant improvement in yield determination. Techniques for improved accuracy of yield determination over a range of yields were investigated.

- Efforts were made to provide a firm technical basis for support to the ongoing Nuclear Test Experts Talks in Geneva.

- Data Acquisition/Analysis. Data from the small advanced-design array in Norway (NORESS) were studied to determine the detection capability of small explosions using high-frequency seismic waves. Development of a second advanced array was begun in northern Scandinavia as part of the overall demonstration experiment to evaluate the monitoring effectiveness of a network of small advanced high-frequency arrays in geological areas analogous to that found in the Soviet Union. A program was initiated to design an advanced array signal processing system using Artificial Intelligence to assess the data from the high-frequency array demonstration experiment.

- Support to International Negotiations. A new concept for an international monitoring system was presented to the United Nations Conference on Disarmament. Initial experiments on the global exchange of large volumes of waveform data were conducted using the facilities of the prototype International Data Center at the DARPA Center for Seismic Studies.

- Nuclear Materials Detection (TIARA). Final design of a complex imaging neutron detector array and an imaging, high-resolution gamma-ray detector neared completion. These new detectors should have the capability to improve significantly the detection and characterization of nuclear materials, processes which emit radiation. Evaluation of experimental approaches to neutrino detection continued.

FY 1988 Planned Program:

- Yield Estimation. Final testing and evaluation of the improved yield estimation techniques will be carried out. Development will begin on a system to conduct the required analyses required for the new techniques in an efficient manner. Efforts will be made to begin the process of transferring this new technology to operational systems. Testing of the new highly accurate methods on lower yields will be carried out. Fundamental work in mathematics and statistics will be begun to examine how this technology should be integrated into monitoring procedures.

- Data Acquisition/Analysis. Development and installation will be completed on the advanced high-frequency array (FINESS) in northern Scandinavia. Practical demonstrations of high-frequency propagation characteristics will be designed and tested using the new data from the Scandinavian arrays. Development will continue on the intelligent array processing system which will be installed at the DARPA Center for Seismic Studies. The system will optimize processing of data from multiple high-frequency arrays and should demonstrate significantly improved capabilities to detect small events.

- Support to International Negotiations. Direct technical support will be provided to the US/USSR Nuclear Testing Negotiations on improving yield threshold verification. The program will also provide support for the planning and conduct of any Joint Verification Experiments with the Soviet Union. Technical support will also be provided to the Conference on Disarmament to plan and test a modern international data exchange system, including the establishment of the U.S. International Data Center at the DARPA research facility.

- Funding was added by Congress in the FY88 appropriation to reinvigorate the seismic verification research effort and to follow up on progress being made in the current program and by that in the university program. The increased

funding is being used to augment funding for seismological research at individual universities (with particular emphasis on high frequency signal propagation and decoupling research), to increase participation in the global digital seismic network, to accelerate the advanced array program, and to support any US/USSR Joint Verification Experiments.

- Nuclear Materials Detection (TIARA). Development of nuclear materials detection technology with emphasis on extreme sensitivity and new radiation imaging techniques will continue. These investigations and technical demonstrations will lead to advnaces in monitoring equipment which relies on radiation detection technology. Prototypes of the new detectors will be tested in high-altitude balloon flights from Australia and Antartica to simulate space conditions.

FY 1989 Planned Program:

- Yield Estimation. Improved advanced methods of yield estimation will be tested and applied in operational use for their applicability to the estimation of lower yields.

- Data collected in any US/USSR Joint Verification Experiments will be incorporated into the new yield estimation methods.

- Data Acquisition/Analysis. The prototype intelligent array processing system will be installed at the DARPA Center for Seismic Studies and an evaluation of the capabilities of this system will begin.

- Support to International Negotiations. Technical support to the discussion of possible US/USSR Joint Verification Experiments will be continued, including the possibility for deploying U.S. seismic equipment in the Soviet Union for use in such an experiment. Final planning of the large scale global test of the international monitoring system will be completed under the auspices of the Conference on Disarmament. Testing of critical elements of this system will begin. This will involve the establishment of a direct high-speed communications network between the International Data Centers in Washington, Sweden, the Soviet Union and Australia.

- Nuclear Materials Detection. Neutron and Gamma-ray detectors and imaging methods will be tested in realistic environments.

Program to Completion:

- The research program has supported the U.S. government efforts to achieve effective verification of the Threshold Test Ban Treaty. The seismic research requirements in future years will be driven by negotiation opportunities as they appear. The program is structured to be flexible to respond to possible future requirements for treaty monitoring. Because of the element of possible evasion or non-compliance, the program is a continuing one. Verification capabilities which might be needed for future test limitations are not yet firmly established. Development of nuclear materials detection technology with emphasis on extreme sensitivity will be continued.

D. WORK PERFORMED BY: Approximately 67% of this work is performed by industrial contractors, 18% in-house laboratories, 7% foreign, and 8% university. Major

performers include: Teledyne Geotech, Garland, Texas and Alexandria, Virginia; Lockheed Palo Alto Research Laboratory, Palo Alto, California; Science Applications International Corp., McLean, Virginia and San Diego, California; Science Horizons Inc., Encinitas, California; the University of Florida, Gainsville, Florida; Southern Methodist University, Dallas, Texas; University of Colorado, Boulder, Colorado; Sandia National Laboratories, Albuquerque, New Mexico, and Los Alamos National Laboratory, Los Alamos, New Mexico.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY: No change in FY1989.

F. PROGRAM DOCUMENTATION: Not Applicable

G. MILESTONE SCHEDULE:

Plan	Milestone
Jan 1988	Testing of prototype of a gamma-ray detector.
1988	Possible US/USSR Joint Verification Experiment (tentative)
Sep 1988	Advanced yield estimation methodology tested
Apr 1989	Demonstration and evaluation of high frequency analysis processing system.
Sep 1989	Delivering of space-borne neutron and gamma detector arrays for integration to spacecraft.
Jan 1990	Conduct of international Data Exchange Experiment under auspices of Conference on Disarmament, Group of Scientific Experts
Jul 1990	Space tests of nuclear radiation detectors

H. RELATED ACTIVITIES: Complementary research is conducted by the National Laboratories of the Department of Energy and by the Air Force Technical Applications Center (AFTAC) for operational applications. These efforts are coordinated through existing interagency agreements and periodic working level coordination meetings.

I. OTHER APPROPRIATION FUNDS: None

AMENDED FY 1988-1989 BIENNIAL
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Title: Experimental Evaluation of Major Innovative Technologies

Budget Activity: 2. Advanced Technology Development

A. RESOURCES ($ in thousands)

Project Number	Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Programs
EE-02	Teal Ruby Experiment	5,865	$2,420	0	301,480
EE-03	X-Wing/RSRA	54,378	0	0	164,797
EE-09	X-29 Advanced Technology Demonstrator	230	1,000	2,000	133,504
EE-19	Long Range Interceptor Experiment	8,660	0	0	11,288
EE-17	Detection of Aircraft (HI-CAMP)	2,979	2,681	3,000	12,000
EE-18	Advanced Undersea Technology	14,646	26,500	20,000	Continuing
EE-19	Advanced Cruise Missile Technology	4,000	6,000	6,000	Continuing
EE-21	Armor/Anti-Armor	2,300	18,282	44,000	Continuing
EE-23	Enhanced Fighter Manueverability	0	15,000	20,000	80,900
EE-24	Advanced Short Takeoff Vertical Landing	0	5,000	10,000	Continuing
EE-25	Tactical Airborne Laser	0	20,000	0	20,000
EE-26	Hypersonics Weapons Technology	0	25,000	25,000	235,000
EE-27	LIGHTSAT	0	(35,000)*	34,000	235,000
EE-28	Unmanned Undersea Vehicle	0	25,000	10,000	TBD
EE-29	Low Observable Technology Base	0	5,000	5,046	TBD
TOTAL FOR PROGRAM ELEMENT**		151,774	215,133	225,046	TBD

* Funded in PE 0602301E in FY 1988
** Total includes classified projects not identified herein.

B. PROGRAM ELEMENT DESCRIPTION: This program element is dedicated to the demonstration, evaluation and/or prototyping of advanced research and development concepts. Projects No's EE-18, EE-21, EE-23, EE-26 EE-27, and EE-28 are described in separate Descriptive Summaries.

AMENDED FY 1988-1989 BIENNIAL
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
Project Number: #EE-02
Project Title: TEAL RUBY Experiment

TITLE: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

B. BRIEF DESCRIPTION OF PROJECT: Program is a space experiment to demonstrat infrared detection of strategic aircraft from a space platform, measure target and cluster background signatures from space,and demonstrate advanced infrared mosaic detector technology.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

Completed sensor spacecraft system testing.
Completed closeout/verification of data processing software.
Completed modifications to earthshield structure for Shuttle loads.
Began re-work of uplink/downlink software run on new Satellite Control Facility's new computer system (DSM).

FY 1988 Planned Program:

Congress zeroed DARPA funds for TEAL RUBY sensor.

FY 1989 Planned Program: N/A.

Program to Completion: N/A.

D. WORK PERFORMED BY: Rockwell International, Seal Beach, CA; and Air Force GeophysicsLaboratory, Hanscom AFB, MA.

E. RELATED ACTIVITIES:

Program Element # 0603226E - Detection of Aircraft
Program Element # 0603402F - AF Space Test Program
Program Element # 0603741D - OSD Air Defense Initiative

F. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988-1989 BIENNIAL
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
Project Number: #EE-09
Project Title: X-29 Advanced Technology Demonstrator

Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

B. BRIEF DESCRIPTION OF PROJECT:: Program is designed to develop and demonstrate advanced aerodynamics, structures and flight control technologies.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

Flight research continued on the first X-29A aircraft.
Performance, stability, and control test data correlated and compared to analytical and wind tunnel predictions to validate the design process and create the data base necessary to transition the X-29A results.
Military utility was evaluated using handling qualities testing for air combat maneuvering and air-to-air tracking tests.

FY 1988 Planned Program:

Research efforts will focus on advanced aerodynamic, structural, and flight control technologies.
Research flight testing on the first aircraft will be completed.
Second aircraft will begin modification to install a spin parachute and augmented flight control system and instrumentation for high angle of attack testing.
Second vehicle will be delivered to Edwards AFB, CA to begin extensive ground testing of flight control system and certification of the spin parachute.

FY 1989 Planned Program:

Flight testing of aircraft number two.
Gradual build-up in angle of attack and angular rate will provide flight safety near the stall boundary of the flight envelope.
Evaluate control systems effectiveness in roll and pitch axes at high angles of attack to validate design goals of forward swept wing.

Program to Completion:

First quarter of FY 90 will involve data reduction and reporting of test results and comparisons with analytical predictions.

D. WORK PERFORMED BY: Grumman Aircraft Corporation, Bethpage, NY; NASA Langley Research Center, Norfolk, VA; and NASA Ames - Dryden Flight Research Facility, Mountain View, CA.

E. RELATED ACTIVITIES: DARPA Air Force Memorandum of Agreement established Air Force Systems Command and the Agent responsible for procurement and technical monitoring of design and fabrication and test efforts. DARPA/NASA Memorandum of Agreement established Dryden Flight Facility as primary test support organization.

F. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988-1989 BIENNIAL
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
Project Number: #EE-17
Project Title: Detection of Aircraft (HI-CAMP)
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

B. BRIEF DESCRIPTION OF PROJECT: Program addresses the phenomenology and hardware/software technology for the development of space based or high flying infrared surveillance systems for the detection of aircraft on ground targets.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

Collected data against BQM-107 drones at White Sands.
Successfully gathered IR target and background data simultaneously with the B-1 prototype radar for use in developing new concepts for sensor fusion.
Collected data on strategic relocatable targets.
Completed development of new target, background and atmospheric models/distributed to community.

FY 1988 Planned Program:

Collections planned against strategic missiles; laser sources; strategic and tactical aircraft artillary-firing and non-firing; Navy carrier aircraft operations.
Participate in additional sensor fusion collections.
Deploy HI-CAMP sensor to United Kingdom for installation in UK aircraft and participate in collection against wide variety of targets.

FY 1989 Planned Program:

Complete program in the United Kingdom.
Continue long range aircraft, sensor fusion and ballistic missile plume measurements.
Continue real-time algorithm developments.

Program to Completion:

Complete data analysis of collected phenomenology.
Transition HI-CAMP II sensor to another Agency/Service.

D. WORK PERFORMED BY: Lockheed Missile and Space Company, Palo Alto, CA; MRJ Corporation, Fairfax, VA; ERIM, Ann Arbor, MI; Air Force Geophysics Laboratory, Hanscom AFB, and Naval Ocean Systems Center, San Diego, CA.

E. RELATED ACTIVITIES:

Program Element # 0603226E, TEAL RUBY
Program Element # 0602301E, Strategic Technology, Advanced Concepts; Broad Area Search and Surveillance
Program Element # 0603741D, Air Defense Initiative

F. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603226E Title: Experimental Evaluation at Major Innovation Technologies

Project Number: EE-18 Budget Activity: 2. Technology Base

Project Title: Advanced Undersea Technology (AUT)

A. RESOURCES ($ in Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
AUT	14,646	24,500	20,000	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:
The objective of this program is to develop and demonstrate advanced in technology required for autonomous undersea systems. Technology areas to be investigated include: Autonomous navigation systems, high energy density power sources, advanced propulsion systems, low drag vehicle designs, advanced autonomous sensors, covert acoustic communications and autonomous control logic.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- Demonstration of the low drag vehicle design at higher speeds and in salt water was conducted in the Langley Tow Basic. The Terrain and Obstacle Avoidance Sonar (TOAS) system was tested and delivered. Autonomous logic for the TOAS was completed. Mission studies were completed which identified and demonstrated alternative uses for autonomous vehicles. At-sea demonstrations of the intelligent control of Multiple AUV's were completed. Cooperative AUV activity was demonstrated using two EAVE East Vehicles with acoustic sensors. The activities demonstrated included search, hazard avoidance and coordinated attack.

FY 1988 Planned Program:

- Field demonstrations will continue in FY 88 and simulation of performance will be completed.

FY 1989 Planned Program:

- Further activities during FY 89 will concentrate on the development of advanced autonomous sensors, (e.g. a second generation TOAS, an Acoustic Intercept Receiver) and advanced energy/propulsion systems, (e.g. an advanced SCEPS, a diesel SCEPS, a secondary Lithium battery, or an artificial gill). Mission details as well as some Advanced Undersea Vehicle technology items can only be addressed at a higher classification level.

Program to Completion:

- This is a continuing program.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603226E Title: Experimental Evaluation at Major Innovation Technologies

Project Number: EE-18 Budget Activity: 2. Technology Base

Project Title: Advanced Undersea Technology (AUT)

D. WORK PERFORMED BY: Major contractors are Rockwell International, Scientific Research Laboratories, the Applied Physics Laboratory of the Johns Hopkins University, National Bureau of Standards, Decisions Sciences, Inc. and the University of New Hampshire.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY: No change.

F. PROGRAM DOCUMENTATION: Not Applicable.

G. MILESTONE SCHEDULE:

Plan	Milestone
Sep 1988	Complete critical on-going technology demonstrations in hydrodynamics and communications.
Sep 1988	Demonstrate adaptive autonomous vehicle technologies.

H. RELATED ACTIVITIES: Not Applicable.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988-1989 BIENNIAL
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
Project Number: #EE-19
Project Title: Advanced Cruise Missile Technology

Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

B. BRIEF DESCRIPTION OF PROJECT: Program explores high risk/high payoff advances in propulsion technology program for the next generation of cruise missiles.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

Combined DARPA ELITE program for high temperature turbine components with USAF Expendable Turbine Technology Components (ETEC) program.

Redesigned USAF lab engine as test bed for Carbon-Carbon (C-C) turbine demonstration.

Completed high temperature tests of C-C coatings/high stress tests of rotor blades.

FY 1988 Planned Program:

Hot spin at 3100F of full size turbine rotor.
Fabrication of six turbine rotors for USAF ETEC program.
Fabrication of modifications to raise temperature of ETEC engine to evaluate C-C turbine.

FY 1989 Planned Program:

Assemble modified ETEC engine with C-C turbine and run at elevated temperatures.

Program to Completion:

Develop validated engineering data to permit design of high performance CM engines for subsonic and supersonic applications.

D. WORK PERFORMED BY: LTV Aerospace, Dallas, TX.

E. RELATED ACTIVITIES: None.

F. OTHER APPROPRIATED FUNDS: None.

AMENDED FY 1988-1989 BIENNIAL
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
Project Number: #EE-24
Project Title: Advanced Short Takeoff/ Vertical Landing
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

B. BRIEF DESCRIPTION OF PROJECT: Program is designed to demonstrate the feasibility of high performance supersonic aircraft with vertical lift capabilities

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program: (funded by Nunn Quayle and Balanced Technology Initiative)

Conceptual aircraft designs for national NAVY/USMC missions.
Conceptual engine designs for ASTOVL aircraft using modern engines.
Fabricate and test of scale model aircraft in wind tunnels.
Design and test of test rigs to explore ASTOVL unique nozzles, inlets, etc.
Definition of a STOVL technology testbed to explore propulsion issues.
Negotiated data exchange with UK on complementary investigations.
Cooperative task with USAF for high temperature tests on USAF engine.

FY 1988 Planned Program:

Computer performance simulation of DoN/USMC conceptual aircraft designs.
Laboratory tests of hot gas flow from ASTOVL nozzles/scaled aircraft.
Wind tunnel test of E-7 scale model aircraft.
Flight test on NASA YAV-8B of STOVL flight controls experiment.
Computer simulation of propulsion control architecture.
Develop criteria for demonstration aircraft.

FY 1989 Planned Program:

Develop rationale for demonstration aircraft.
Define critical technologies for validation.
Explore possibility of joint participation MOU with UK in demonstrator fabrication.

Program to Completion:

Fabrication and test of demonstration aircraft.

D. WORK PERFORMED BY: General Electric, Evendale, OH; Pratt & Whitney, Palm Beach, FL; McDonnell-Douglas Aircraft Company, St. Louis, MO; Lockheed Aircraft Corporation, Burbank, CA, NASA Ames Research Center, Sunnyvale, CA; and NASA Lewis Research Center, Norfolk, VA.

E. RELATED ACTIVITIES:

U.S./UK Memorandum of Understanding, Supersonic STOVL Research
Program Element # 0603790D, NATO Cooperative Program
Program Element # 0603737D, Balanced Technology Initiatives

F. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988-1989 BIENNIAL
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
Project Number: #EE-25
Project Title: Tactical Airborne Laser Communication

Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

B. BRIEF DESCRIPTION OF PROJECT: Program will assess the military and technological utility for communications between submarine and airborne platforms using laser transmitters.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program: N/A.

FY 1988 Planned Program:

Define the operational utility of proposal system for several submarine missions.
Define the technology requirements for air and submarine mounted lasers and optical receivers.
Develop environmental models and conduct testing of laser uplines to determine feasibility of such systems.

FY 1989 Planned Program: N/A.

Program to Completion:

To be determined as a result of testing in FY 1988.

D. WORK PERFORMED BY: Not Selected.

E. RELATED ACTIVITIES: None.

F. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988-1989 BIENNIAL
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
Project Number: #EE-29
Project Title: Low Observable Technology Base

Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

B. BRIEF DESCRIPTION OF PROJECT: Program is designed to develop and demonstrate the applications of low observable technology to prototype systems.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program: N/A

FY Planned 1988 Program:

Conceptual techniques will be validated in small scale tests.

FY 1989 Planned Program:

During FY 1989 applications that show promise in the FY 1988 testing program will be continued.

Program to Completion:

Continue to develop and demonstrate low observable technology techniques for prototype applications.

D. WORK PERFORMED BY: Institute for Defense Analyses, Alexandria, VA; General Image Engineering, Salt Lake City, UT; Photon Research Associates, Los Angeles, CA; and Naval Research Laboratory, Washington, DC.

E. RELATED ACTIVITIES: None.

F. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Title: Experimental Evaluation Project of Major Innovative Technologies
Number: EE-21
Project Title: Armor/Anti-Armor Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Armor/Anti-Armor	2,300	18,282	44,000	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

In late 1985 the Defense Science Board reported that Soviet Armor and Anti-Armor had improved dramatically. Their conclusion was that we are behind and falling further behind in this area. Later assessments indicate a worsening of this situation.

Requirements driven by this situation are Free World improvements in both light and heavy armor to provide significantly improved protection at reduced weight. In addition, kinetic and chemical energy warheads that will defeat current and planned Soviet armors must be developed rapidly. In response to these requirements, the Secretary of Defense tasked the Defense Advanced Research Projects Agency (DARPA) to lead a joint DARPA/Army/U.S. Marine Corps advanced research program to enhance the state-of-the-art in blue protection and penetration technology and lay the basis for a competitive modernization rate.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program:

- Initial contractor tests of light and heavy armor and chemical energy warheads completed.

FY 1988 Planned Program:

- Perform ballistic analysis of program products at the Advanced Technology Assessment Center at Los Alamos, NM.
- Identify technology candidates for near term applications and put them on a "fast track" for Service transition.

FY 1989 Planned Program:

- Continue promising development efforts to support competitive modernization rate.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Title: Experimental Evaluation of Major Innovative Technologies
Project Number: EE-21
Project Title: Armor/Anti-Armor Budget Activity: 2. Advanced Technology Development

Program to Completion:

- Defense Advanced Research Projects Agency, Army, US Marine Corps Memorandum of Understanding is for five years, ending in FY 1990.
- Certain program technologies will be "harvested" as soon as FY1988-1989. However, due to the open-ended nature of the threat, this is a continuing program.

D. WORK PERFORMED BY: The major performers are DuPont Composites, Wilmington, Delaware; ALCOA Defense Systems, ALCOA Center, Pennsylvania; Honeywell, New Hope, Minnesota; FMC Ordnance, San Jose, California; General Motors Military Vehicle, Indianapolis, Indiana; General Dynamics Land Systems, Warren, Michigan; and General Electric, Pittsfield, Massachusetts.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

CHANGE	Schedule	Schedule Change	Budget Year Cost

Not available.

NARRATIVE DESCRIPTION OF CHANGES

None.

F. PROGRAM DOCUMENTATION: Not applicable.

G. MILESTONE SCHEDULE: Not available.

H. RELATED ACTIVITIES:

Program Element 0602702E/Project TT-04. Armor/Anti-Armor Research and Electromagnetic Gun.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988-1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: # 0603226E
Project Number: EE-23
Project Title: Enhanced Fighter Maneuverability

Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
X-31A	0	15,000	20,000	80,900

B. BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES: The Enhanced Fighter Maneuverability (EFM) program will integrate and demonstrate a number of emerging technologies that collectively have the potential to significantly increase fighter aircraft agility and to improve close-in combat (CIC) exchange ratios. The technical challenge is to produce a low-cost flight vehicle that will demonstrate the payoff of high agility at high angles of attack, using thrust vectoring, integrated flight and propulsion control systems, and tailored configuration design. Two flight demonstrator aircraft will produce data on the technical and military implications of post-stall maneuvering provided by EFM. Flight test will provide both research data for the relatively unexplored flight regime at high angles of attack, and will also provide a preliminary tactical assessment of post-stall maneuvers for close-in aerial combat. A low-cost approach to flight demonstrators will be used, and a data base for such proof-of-concepts flight vehicles will be generated for future application.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program: This program was initiated and funded in FY 1986 and FY 1987 as a joint program with the Federal Republic of Germany under the Nunn-Quayle NATO Cooperative Research and Development Program. FY 1987 efforts were primarily centered on initiation of the Concept Validation and Design phase (Phase Two) of the program, establishment of a vehicle preliminary design, and conduct of a Preliminary Design Review.

- Concept feasibility phase completed in early FY 1987.
- Phase Two (vehicle design) contract initiated.
- Initial series of wind tunnel tests were conducted.
- Studies in crew protection and advanced cockpit design.
- Preliminary Government Furnished Equipment (GFE) list compiled.
- Discussions were conducted on the work split between Rockwell International and Messerschmitt-Bolkow-Blohm (MBB).

AMENDED FY 1988-1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: # 0603226E
Project Number: EE-23
Project Title: Enhanced Fighter Maneuverability

Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

FY 1988 Planned Program:

- Detailed design of vehicle will be completed.
- German work packages will produce completed designs for the wing, flight control, and thrust vectoring systems.
- Phase Three (fabrication) and Phase Four (flight test) planning will be conducted.
- Long lead time items and preliminary tooling will be acquired to support fabrication phase.
- Phase Three proposal submission, fact finding, and contract negotiations will occur late in the fiscal year.

FY 1989 Planned Program:

- Activities centered on Phase Three fabrication and assembly of the two X-31A demonstrator aircraft.
- Low cost experimental shop fabrication and assembly techniques will be documented for use by other programs.

Program to Completion:

- Fabrication, assembly, and ground testing of both X-31A aircraft will be completed at the Rockwell International facility in Palmdale, CA.
- Phase Four flight test program will be conducted at the Naval Air Test Center, Patuxent River, MD.
- First flight of the X-31A in late CY 1991.
- Envelope expansion flights will be followed by preliminary tactical utility evaluations.
- New tactical maneuvers will be evaluated with similar (both X-31A aircraft) and dissimilar aircraft participating.

D. WORK PERFORMED BY: Rockwell International Corporation, Los Angeles, CA; General Electric Corporation, Lynn, MA; Sperry Honeywell, Albuquerque, N.M.; Naval Air Test Center, Patuxent River, MD; Naval Air Development Center, Warminster, PA; and NASA Langley Research Center, Hampton, VA.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

Change	Schedule	Schedule Change	Budget Year Cost
Cost:	The additional funds partially address a a budgeting shortfall for the Phase Three fabrication and assembly effort.	Funding available results in a first flight slip of approximately two years.	$10,000

AMENDED FY 1988-1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: # 0603226E
Project Number: EE-23
Project Title: Enhanced Fighter Maneuverability

Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

NARRATIVE DESCRIPTION OF CHANGES

COST CHANGES: The increased cost estimate for the program reflects: 1) an insufficient budget estimate for GFE; 2) unbudgeted costs associated with multinational management, design, and development activities; and 3) a firm cost proposal for the Phase Three fabrication and assembly effort.

F. PROGRAM DOCUMENTATION: Not applicable.

G. MILESTONE SCHEDULE:

Plan	Milestones
Jul 1987	Preliminary Design Review
Jun 1989	Critical Design Review
Jun 1991	Flight Readiness Review
Dec 1991	First Flight

H. RELATED ACTIVITIES:

- EFM Memorandum of Agreement between DARPA and the West German Federal Ministry of Defense is the governing document addressing U.S. and West German financial commitments to the program.
- A Supermaneuverability Steering Group has been established between DARPA, NASA, the Navy, and the Air Force to coordinate research and technology demonstrations in the area of high angle of attack flight and to provide a mechanism for disseminating X-31A generated data on post-stall maneuvering.

I. OTHER APPROPRIATION FUNDS:

Program Element 0603790D: NATO Research and Development Program funds: ($ in thousands)

FY 1986	FY 1987
10,500	21,000

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
Project Number: #EE-26
Project Title: Hypersonic Weapon Technology
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Hypersonic Weapon Technology	$ 0 *	$25,000	$25,000	$230,500

B. BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES: The proposed Hypersonic Weapon Technology (HWT) Program is a research and development effort to design, fabricate and demonstrate a robust capability for multi-mission air defense. This program will develop the necessary weapon and surveillance technologies for medium and long range air defense. HWT draws together several of the DARPA technology programs, such as the Advanced X-Band Intercept Sensor (AXIS), the Global Positioning System (GPS) Guidance Program (GGP) and the Miniature GPS Receiver (MGR) programs, into a total integrated concept. All FY 1988 and out-year efforts described below are contingent on a Memorandum of Agreement being signed by two Services and DARPA, and their joint concurrence on this work.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program* : The HWT Program had several weapon sensor and guidance technology efforts on-going in FY 1987. Major program accomplishments during that period were as follows:

- Awarded Phase I AXIS contract to Raytheon for an X-band conformal array radar development, acquisition of real world X-band radar clutter data and clutter suppression algorithm verification.

- Established the Integrated Guidance System (IGS). This system is composed of an AXIS radar, a MGR and high performance fiber optic gyro-based inertial measurement unit (GGP).

- Issued a broad area announcement (BAA), evaluated nine industry bids, and selected three contractor teams to develop a GGP within a 3-4 year timeframe.

- Issued a BAA and awarded five contracts to define advanced anti-air and precision surface strike weapon system concepts that might utilize IGS and advanced hypersonic technologies.

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* FY87 and prior year funding out of Project EE-16, Long Range Air Interceptor Experiment (LORAINE) Program

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
Project Number: #EE-26
Project Title: Hypersonic Weapon Technology
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

- Completed comparisons of ramjet-powered and rocket-powered anti-air interceptors. The performance model for the latter vehicle was based on the Sandia Winged Energetic reentry Vehicle Experiment (SWERVE).

- Determined appropriate materials and material processing for conformal antenna element windows for hypersonic weapon radars.

FY 1988 Planned Program: The following major activities are planned for the new HWT project in FY 1988:

- Memorandum of Agreement for HWT signed by two Services and DARPA.

- Begin the AXIS monolithic microwave integrated circuit (MMIC) transmit/receiver (T/R) modules fabrication.

- Raytheon, SANDIA and Lockheed will begin the design of the sensor pallet and begin fabrication.

- Develop and assess three separate designs for GGP. Select two best concepts for fabrication phase of program. Begin development of key GGP components.

- Obtain selected MGR integrated circuit chips and assess performance in GPS testbed for geo-location sensing.

- Solidify multi-mission air defense requirements. Resolve all outstanding issues concerning targets/threats, survivability, C^3I interoperability and weapon launch.

- Complete five anti-air and precision surface strike weapon studies. Assess their performance in meeting multi-mission air defense requirements.

- Conduct a statement of interest briefing and request for proposal for the design and fabrication of the most promising mission concept.

- Evaluate received proposals and select contractor(s) for multi-mission demonstration program.

FY 1989 Planned Program: Based on the results of FY 1988, the following activities are planned for FY 1989:

Program Element: #0603226E Title: Experimental Evaluation
Project Number: #EE-26 of Major Innovative Technologies
Project Title: Hypersonic Weapon Technology Budget Activity: 2. Advanced Technology Development

- Continue the development of the GGP piece parts and evaluate completed items. Begin assembly of high performance brassboard inertial measurement unit.

- Begin upgrade AXIS MMIC T/R modules.

- Assemble medium performance GGP unit for early unmanned vehicle demonstration.

- Develop MGR performance capability to meet strike weapon maneuverability requirements.

- Continue fabrication of AXIS sensor pallet.

- Initiate multi-mission air defense demonstration program.

- Initiate technology programs required to support above demonstration program.

Program to Completion: This is a continuing program.

D. WORK PERFORMED BY: The major contractors performing work on HWT are: Sandia National Laboratory, Albuquerque, NM; Raytheon Company, Bedford, MA; Texas Instruments, Dallas, TX; Lockheed Missiles and Space Company, Sunnyvale, CA; Martin Marietta Corporation, Orlando, FL; McDonnell Douglas Astronautics Company, St. Louis, MO; Boeing Aerospace Company, Seattle, WA; and General Dynamics, San Diego, CA.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY: The FY 1988 DARPA Descriptive Summary discussed only the LORAINE program. Congressional guidance combined the Navy Hypersonic Wide Area Defense Missile and the Air Force Boost Glide Vehicle Programs with the DARPA LORAINE effort to form HWT.

F. PROGRAM DOCUMENTATION: Not applicable.

G. MILESTONE SCHEDULE:

Plan	Milestone
Sep 89	Medium performance GGP built.
Dec 89	Multi-mission air defense demonstration program begins.

Program Element: #0603226E
Project Number: #EE-26
Project Title: Hypersonic Weapon Technology
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

Sep 90 High performance GGP built.

H. RELATED ACTIVITIES: There are no related activities in this area.

I. OTHER APPROPRIATION FUNDS: None.

AMEND FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
Project Number: EE-27
Project Title: LIGHTSAT

Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
LIGHTSAT	0	* $35,000	$34,000	$234,000

* Funded out of Project ST-14, PE 0602301E in FY 1988.

B. BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES:

The primary and immediate goal of the ASTP is to develop low cost expendable launch vehicle systems capable of placing 400 to 1500 pound spacecraft into low earth orbit. Availability of such vehicles would enable a launch on demand capability to meet the needs of rapidly evolving military situations and would limit the dependency of the U.S. on today's large and capable but vulnerable and relatively inflexible space forces.

DARPA expects to demonstrate small inexpensive boosters and lightweight low orbit satellite systems, austere but responsive to the commander's needs, with on-orbit costs on the order of one-tenth those of current national systems.

LIGHTSAT payloads are being developed for UHF communications relay, digital data store and forward and reconstitution of GPS. LIGHTSAT launch vehicles will be small enough to be road/rail or air mobile; a fleet of boosters located in the U.S. would achieve survivability by dispersal, and would be launched as needed by the operational commander. LIGHTSAT ground stations would be small and simple enough to be mobile in the theater; no tracking dish antenna will be needed.

A secondary LIGHTSAT goal is to demonstrate on orbit new technology and techniques which could allow major cost savings for national satellite systems as well.

The first LIGHTSAT payloads, a UHF data and communication system, will be launched by an interim Small Launch Vehicle (ILV) based on well-understood current technologies, to allow early demonstration and test of the new payload concepts. Later payloads will be launched by a Standard Small Launch Vehicle (SSLV) with larger payload capability.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 87 Program: This program does not begin until FY 1988.

AMEND FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
Project Number: EE-27
Project Title: LIGHTSAT

Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

FY 1988 Planned Program: *

- Begin design of ILV. Conduct engine and component tests.
- Examine air launched options
- Conduct design competition for SSLV; select one or more SSLV designs and begin manufacture.
- Begin design and manufacture of first LIGHTSAT payload.
- Complete plans for operational tests in EUCOM.

* Funded out of Project ST-14, PE 0602301E in FY 1988.

FY 1989 Planned Program:

- Complete booster engine ground tests.
- Complete guidance and control design and fabrication.
- Complete SSLV design and begin fabrication.
- Complete first LIGHTSAT payload fabrication and ground tests.
- Complete ILV fabrication and ground tests.
- Conduct first launch and test program.

Program to Completion:

- Evaluate results from first LIGHTSAT experiments.
- Complete design, fabrication, test, and launch of SSLV.
- Develop further LIGHTSAT payloads for on-orbit demonstration.
- Transition completed system to appropriate Service for quantity buy.

D. WORK PERFORMED BY: ILV contractor not available; will be competed. Initial payload design by Defense Systems, Inc. Interim engineering support by MCS Corporation.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY: New program not included in last year's Descriptive Summary.

F. PROGRAM DOCUMENTATION: Not Applicable.

G. MILESTONE SCHEDULE:

Plan	Milestone
Jan 88	System Engineering Solicitation
Feb 88	ILV Solicitation
Feb 88	Broad Agency Announcement for Air Launched Option
Mar 88	SSLV Solicitation
Mar 88	ILV Award

Program Element: #0603226E
Project Number: EE-27
Project Title: LIGHTSAT

Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 2. Advanced Technology Development

Mar 88	Spacecraft Broad Agency Announcement
Apr 88	SSLV Award
Aug 88	SSLV Development
Jul 89	ILV - initial launch
Jan 90	SSLV - initial launch

H. RELATED ACTIVITIES: The ASTP is intentionally independent of other boost vehicle and spacecraft and development program approaches in order to achieve its goals of short development time, low cost, and utilization of available technology in the most straightforward manner possible.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Title: Experimental Evaluation of Major Innovative Technologies
Project Number: EE-28
Project Title: Unmanned Undersea Vehicle Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
UUV Prototype	0	$25,000	$10,000	TBD

B. BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES: The objective of this program is to develop and demonstrate concepts for operation of Unmanned Undersea Vehicles. Two specific missions are to be demonstrated.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program: Not Applicable (New Start).

FY 1988 Planned Program:

- This year the program is designing and commencing fabrication of a UUV. The system performance specifications for the UUV and that mission are being develop, a competitive procurement for the mission subsystem and integration is to be completed, and mission subsystem design is commencing. Studies are refining the operational concepts.

FY 1989 Planned Program:

- During FY 1989 fabrication of the UUV and the mission subsystem will be completed, including testing at the component and subsystem level. In-water testing of the UUV will be completed. Integration of the mission subsystem into the vehicle will commence, leading to a full demonstration of an operational environment in FY 1990.

Program to Completion:

- Complete demonstration in an operational environment.
- Develop and demonstrate vehicle.

D. WORK PERFORMED BY: Major contractors are the Charles Stark Draper Laboratory and the Applied Physics Laboratory of the John Hopkins University. Competing contractors include Gould, Honeywell, Lockheed, Martin Marietta, Rockwell International and Westinghouse.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY: Not Applicable (New Start).

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Title: Experimental Evaluation of Major Innovative Technologies
Project Number: EE-28
Project Title: Unmanned Undersea Vehicle Budget Activity: 2. Advanced Technology Development

F. PROGRAM DOCUMENTATION: Not Applicable.

G. MILESTONE SCHEDULE:

Plan	Milestones
FY 89	First UUV Completed
FY 90	Second UUV Completed

H. RELATED ACTIVITIES: Not Applicable.

I. OTHER APPROPRIATION FUNDS: None.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603227E Title: Strategic Relocatable Target
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ In Thousands)

Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Total Program
Strategic Relocatable Targets	0	5,000	15,400	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: This program element was created to provide a capability to attack relocatable targets with U.S. strategic forces. The DARPA program is dedicated to advanced experimentation and analysis to develop means of detecting and identifying mobile Inter-Continental Ballistic Missiles (ICMBs) as well as other strategic relocatable targets, and has extremely high leverage on future strategic plans. The capability to hold these mobile ICBMs at risk requires successful execution of search, detection and identification processes; communication, command and control processes to direct weapons to these targets; and weapon delivery and kill.

One of the most difficult technical issues associated with holding Soviet mobile ICBMs at risk is the detection of these targets in an operational environment. Because these targets are mobile, knowledge of their location must be maintained on a near real-time basis or reacquired prior to weapon release. The rail-mobile SS-24 takes advantage of its indistinguishability from other railroad cars located on the Soviet rail network. To direct a weapon system against these targets, they must be geolocated with an accuracy better than the kill-radius of the weapon. This program element includes experimentation and analysis, and puts strong emphasis on building a scientific base in detection and identification signatures, sensors and processing. The accompanying analytic effort will develop robust detection and identification algorithms. Operational effectiveness analysis will also be conducted to develop analytical models to assess alternative system architectures.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1987 Program: Not applicable - this is a new start in FY 1988.

FY 1988 Program: Major elements of this program have been initiated this year:

- The first effort is to understand the fundamental characteristics of the detection process of targets in a cluttered environment. The work is being performed by the Lincoln Laboratory of Massachusetts Institute of Technology (MIT/LL) and will include the development of analytical methods which will be verified by flight testing of existing/modified developmental sensors against real vehicles. Flight tests will be conducted in conjunction with Service SRT tests in addition to calibration/verification testing necessary for the development of sensor models.

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603227E Title: Strategic Relocatable Target
Budget Activity: 2. Advanced Technology Development

- Additional systems effectiveness analysis will be performed in support to the DoD Relocatable Target Steering Panel. This includes development of methodologies to evaluate candidate operational concepts, and establishment of a structured plan to assess various systems, force structures, capabilities and cost tradeoffs.

FY 1989 Planned Program:

- The MIT/LL effort will conduct extensive flight testing of developmental sensors against targets in clutter. The flight testing will include millimeter wave radar, laser radar and high resolution infrared sensors. Flight testing will be conducted in varying clutter conditions, and seasonal climatic conditions and will support the sensor/target modelling required for extension of the sensor performance to other target and sensor conditions.

- The competitive effort will be conducting laboratory and some limited field experiments. These experiments will use existing or modified sensors to gather background data. The laboratory and field data will be used to compute probabilities of detection and area coverage required by operational syst

- Additional systems effectiveness analysis will be conducted to incorporate detailed sensor technical data.

D. WORK PERFORMED BY: Massachusetts Institute of Technology/Lincoln Laboratory, Lexington, MA; TOYON Research Corporation, Santa Barbara, CA.

E. COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

Change	Schedule	Schedule Change	Budget Year Cost
Cost	Signal Measurements of Targets in Clutter	FY 1990	$-2.0

NARRATIVE DESCRIPTION OF CHANGES

Decrease due to an internal agency adjustment will result in delay of some signature measurements of targets in clutter until FY 1990.

F. PROGRAM DOCUMENTATION: Not applicable.

G. MILESTONE SCHEDULE:

AMENDED FY 1988/1989 BIENNIAL BUDGET
RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603227E Title: Strategic Relocatable Target
Budget Activity: 2. Advanced Technology Development

Plan	Milestones
Mar 1988	Target Signature Measurement (SAR, IR, Laser Radar)
Jun 1988	Clutter Measurements
Jul 1988	Summer Target Signature Measurements
Oct 1988	Air Force Collection Exercise Participation
Dec 1988	Technology Roadmap Developed for DoD
Jan 1989	Winter Target Signature Measurements
Feb-Oct 1989	Additional Signature Measurements of Target in Clutter Environment
Jul 1990	Sensor Testbed Development Begins
Jul 1991	Prototype Decision

H. RELATED ACTIVITIES: This program is overseen directly by a Department of Defense Steering Committee consisting of representatives from the Army, Air Force, Intelligence Community, Joints Chiefs of Staff, Office of the Secretary of Defense, and Defense Advanced Research Projects Agency.

The program is closely coordinated with the Air Force Program Element on Relocatable Target Capability (P.E. 63367F). The DARPA program takes advantage of these Air Force exercises to test new technologies and coordinates with the Air Force Wright Aeronautical Laboratory on development of new autoratic target using techniques.

This work is coordinated with PE 0602301E, Advanced Concepts (Project ST-01) and Broad Area Search (Project ST-13). In addition, this project will capitalize on the research efforts achieved in other DARPA programs. Examples of programs include: Smart Weapons, Autonomous Infrared Sensor Technology (AIRSTECH), Millimeter Wave (MMW) Autonomous Sensor, Advanced Digital Radar Imagery Exploitation (ADRIES), Strategic Computing and Tactical Use of National Technical Means (TACNAT).

I. OTHER APPROPRIATION FUNDS: None