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FY 1991 RDT&E Descriptive Summaries

DARPA

January 1990

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FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PE Title: Defense Research Sciences

Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
CCS-02 Advanced Digital Structures & Network Concepts	34,659	34,350	36,551	TBD	Continuing
CCS-03 Modernization Technology	853	0	0	0	____
DRE-01 Technology Exploitation	2,000	0	0	0	____
DRG-01 Geophysical Research	2,517	2,700	3,000	TBD	Continuing
DRH-01 Physical Sciences	5,717	5,450	4,700	TBD	Continuing
DRT-01 Armor Materials Research	4,999	0	0	0	____
ES-01 Electronic Sciences	20,370	18,450	22,008	TBD	Continuing
MS-01 Materials Sciences	17,488	17,200	18,979	TBD	Continuing
Total:	88,603	78,150	85,238		

B. BRIEF DESCRIPTION OF PROJECT: The Defense 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. It involves scientific study and experimentation directed toward knowledge and understanding in those fields of the physical, engineering, and life sciences related to long-term national security needs. It forms a part of the base for (a) subsequent exploratory and advanced developments in defense-related technologies, and (b) new and improved military functional capabilities in areas such as communications, detection, tracking, surveillance, propulsion, mobility, guidance and control, navigation, energy conversion, materials and structures, and personnel support.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PE Title: Defense Research Sciences
Project Number: CCS-02
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
CCS-02 Advanced Digital Structures & Network Concepts	34,659	34,350	36,551	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: Develop the fundamental technology in advanced digital structures and network concepts for smaller, more powerful, less expensive military systems using computer and information technology including artificial intelligence.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:

- Developed integrated design systems that use hardware accelerators which allow designers to deal with the complexity of sub-micron designs, mixed technologies, and system synthesis.
- Demonstrated a uniform workstation user interface, used in a very large distributed environment, in developing a large, complex software system.
- Improved languages and techniques for robotic instruction used to interact with human assistant.
- Demonstrated rudimentary robotic prototypes performing perceptual and reasoning tasks in well-understood task domains with little or no direction from humans except for instruction of very general goal conditions (emphasis on robotics in manufacturing tasks).
- Testbed activities capitalized on previous Defense Advanced Research Projects Agency (DARPA) funded research in machine perception and robotic planning, necessary flexibility and general adaptability in autonomous systems for defense.

FY 1990 Planned Program:

- Development of integrated circuit design tools based on standard functional blocks for creating Applications Specific Integrated Circuits (ASICs) that will be used as accelerator nodes in parallel computing systems.
- Extension of microsystem design tools to include high-performance packaging.
- Demonstration of VLSI circuits which combine analog and digital processing elements for higher performance and greater density.
- Development of wargaming simulation technology for command and control systems that will allow semi-automated forces that require very few personnel for conduct of brigade and division level battle simulations.
- Demonstration of military planning and decision support systems operating in a distributed computing environment provided by another DARPA project (IC-01).

FY 1991 Planned Program:

- Advanced silicon compiler technology will be developed and extended to other design disciplines such as system prototyping.
- Very Large Scale Integrated architecture and design efforts allow development of integrated capabilities for design, fabrication, and test of integrated circuits containing in excess of one million gates and rapid prototyping of systems containing such circuits.
- Implementation of intelligent user interfaces combining natural language and graphic outputs, redundant and user models that anticipate work session scenarios.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PE Title: Defense Research Sciences

Project Number: CCS-02
Budget Activity: 1. Technology Base

- Demonstrate micro electro-mechanical actuators.
- Increase in utility and intelligence of defense systems through software prototyping.

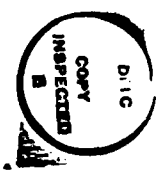
D. WORK PERFORMED BY: FMC Corporation, Minneapolis, MN, University of Utah, Salt Lake City, UT; Ohio State University, Columbus, OH; University of Southern California/Information Sciences Institute, Marina del Ray, CA; Stanford University, Palo Alto, CA; Massachusetts Institute of Technology, Cambridge, MA; University of California at Berkeley, Berkeley, CA; Carnegie-Mellon University, Pittsburgh, PA.

E. RELATED ACTIVITIES: None.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

STATEMENT "A" per Mr. J. Fargo
DARPA/PM-FMD
TELECON 2/12/90 CG



FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PE Title: Defense Research Sciences
Project Number: DRG-01
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
DRG-01 Geophysical Research	2,517	2,700	3,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF PROJECT: Develop basic understanding of the source mechanisms of earthquakes, chemical blasts, and underground nuclear explosions, and of propagation of seismic signals from those sources and methods for using these signals for event discrimination and yield estimation in a nuclear test monitoring context.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Develop numerical and laboratory models of elastic wave propagation in 3-D random media.
- Develop means of precise yield determination using multiple seismic phases.
- Determine the efficiency of signal generation of Soviet nuclear explosion by direct laboratory measurements of field samples taken from the Soviet nuclear site.
- Develop methods of analyzing multispectral LANDSAT and SPOT data.

FY 1990 Planned Program:
- Continue to develop numerical and laboratory models of elastic wave propagation in 3-D random media.
- Continue to develop means of precise yield determination using multiple seismic phases.
- Complete initial determination of the efficiency of signal generation of Soviet nuclear explosions by direct laboratory measurements of field samples taken from the Soviet nuclear site.
- Continue to develop methods of analyzing multispectral LANDSAT and SPOT data.

FY 1991 Planned Program:
- Test theoretical methods for distinguishing earthquakes from explosions on a large data base.
- Test these theoretical methods for explaining observed features of seismic signals by comparison with data taken in the Soviet Union.
- Develop procedures for estimating the size of small nuclear explosions.
- Develop theoretical models for explaining observations and data obtained at Soviet nuclear test sites.
- Extend the multispectral imaging technology to data from other collection platforms.

D. WORK PERFORMED BY: California Institute of Technology, Pasadena, CA; Massachusetts Institute of Technology, Cambridge, MA; Pennsylvania State University, State College, PA; University of California/Berkeley, Berkeley, CA; University of Colorado, Boulder, CO; Southern Methodist University, Dallas, TX.

E. RELATED ACTIVITIES: No other government agency funds basic research in nuclear test detection and discrimination. Scheduled conferences allow all interested agencies to keep abreast of current results of the research effort.

F. OTHER APPROPRIATIONS FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PE Title: Defense Research Sciences

Project Number: DRH-01
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
DRH-01 Physical Sciences	5,717	5,450	4,700	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: The major goals of this project are to develop biosensors for simultaneous, broad-band, chemical agent, microbe, virus and "unknown" agent detection for battlefield anti-chemical/biological-warfare (CBW) and treaty verification; self-assembly of bio-organic microstructures for advanced all-weather, jam-proof radars; applied mathematical techniques for fast signal processing and clustering algorithms for current and future architectures; and new algorithms for determining/optimizing properties of materials.

C. PROGRAM ACCOMPLISHMENTS AND PLAN:

FY 1989 Accomplishments:
- Transitioned Defense Advanced Research Projects Agency (DARPA) silicon biosensor technology for battlefield CBW minidetector to Army.
- Spun off ultra microlithographic process by licensing to industry for advanced semiconductor microfabrication.
- Developed algorithms for computationally efficient Gabor transforms.
- Demonstrated 25 to 50 robust image compression ratios obtained by using wavelet image compression techniques.

FY 1990 Planned Program:
- Complete analysis of influence of polymer parameters on flow modification in strong elongational flows.
- Exploit enhanced Gabor transform for sonar/radar applications.
- Demonstrate proof-of-concept for viral challenge method (VCM); electro-optic (E/O) characterization of VCM-modified saccharides.

FY 1991 Planned Program:
- Evaluate feasibility of microtubule-based films for microwave phase modulation and infrared polarization.
- Fabrication/characterization of E/O active saccharide composites.
- Demonstrate tubule-based cathode structure with current denisity of $\geq$ 50 amp/cm^2 without detrimental formation of cathode plasma. Stable operation $\geq$10 sec (dc).
- Develop increased efficiency algorithms for solving the partial differential equations using wavelet bases.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PE Title: Defense Research Sciences
Project Number: DRH-01
Budget Activity: 1. Technology Base

D. WORK PERFORMED BY: Harvard University, Cambridge, MA; Jet Propulsion Laboratory of the California Institute of Technology, Pasadena, CA; Hughes Research Laboratory, Malibu, CA; AT&T Bell Laboratories, Whippany, NJ; Naval Research Laboratory, Washington, DC; City University of New York, New York, NY; University of California, San Diego, CA; Pennsylvania State University, State College, PA.

E. RELATED ACTIVITIES: Work is coupled to Tri-Service needs through DARPA agents, annual program reviews, quarterly topical reviews and inter-agency and academic participation. These activities assure no unnecessary duplication of efforts occur.

F. OTHER APPROPRIATION FUNDS: Not Applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not Applicable.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PE Title: Defense Research Sciences
Project Number: ES-01
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
ES-01 Electronic Sciences	20,370	18,450	22,008	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: This project explores and demonstrates device, material, and processing concepts that will provide: (1) new technical options for future electronic and optical systems used in information transmission, gathering, and processing; and (2) substantial increase in performance and cost reduction per function. Areas included are: advanced semiconductor processing, new device concepts, reliability and availability of electronics at reduced costs, innovative optical materials and devices, monomolecular thin film structures; and acoustic charge transport (ACT) technology.

C. PROGRAM ACCOMPLISHMENTS AND PLAN:

FY 1989 Accomplishments:
- Continued processing technology development for submicrometer electronics and long wavelength mercury cadmium telluride (MCT) thin films.
- Investigated promising techniques for reconfiguring optical interconnect networks.
- Developed submicron heterostructure bipolar transistors (HBTs) for 94 gigahertz (GHz) power applications.
- Initiated program in artificial neural networks.

FY 1990 Planned Program:
- Demonstrate ACT 256 tap digitally programmable transversal filter with 180 megahertz (MHz) bandwidth and 8 bit tap accuracy.
- Develop 3-dimensional optical storage materials.
- Achieve optical-pulse characterization of resonant tunneling devices.
- Develop low threshold, high frequency arrays of individually addressable vertical cavity semiconductor lasers.
- Demonstrate 94 GHz transistors with 6 db gain and 25% efficiency.

FY 1991 Planned Program:
- Develop high frequency, above 20 GHz, laser modulation techniques.
- Implement lift-off processing technique to achieve versatile optoelectronic circuits.
- Develop coupled quantum well optical switches.
- Demonstrate multiple quantum device circuits.
- Demonstrate MCT on gallium arsenide (GaAs) infrared focal planes.

D. WORK PERFORMED BY: Rockwell International Science Center, Thousand Oaks, CA; Westinghouse Research Center, Pittsburgh, PA; Celanese Research Center, Summit, NJ; Stanford University, Palo Alto, CA; Lockheed Missiles and Space Company, Palo Alto, CA; Lincoln Laboratory, Lexington, MA; and Electronic Devices Incorporated, Urbana, IL.

E. RELATED ACTIVITIES: Efforts in this project are coupled to the Services' program through use of service agents, annual DoD-wide program reviews, and coordination through the Advisory Group on Electron Devices (AGED). These activities assure that no unnecessary duplication of effort occurs.

Program Element: #0601101E
PE Title: Defense Research Sciences
Project Number: ES-01
Budget Activity: 1. Technology Base

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PE Title: Defense Research Sciences

Project Number: MS-01
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
MS-01 Materials Sciences	17,488	17,200	18,979	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: This program is concerned with the development of new materials and concepts for advanced intermetallic compounds; novel processing of ceramics and ceramic composites; and synthesis of stronger and more heat resistant polymers; and development of high power/energy density electrochemical power sources, including batteries and fuel cells.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Developed block copolymers resistant to atomic oxygen for use as solar blankets for protection of satellites in Low Earth Orbit.
- Initiated program on coating of fibers to tailor interfacial strength and chemical resistance of the fibers when incorporated into composites.
- Optimized Lanxide ceramic composites for high temperature strength to improve structural materials and components for missiles and aircraft.

FY 1990 Planned Program:
- Initiate new activity to coat fibers uniformly for use in ceramic matrix and metal matrix composites.
- Ascertain whether or not it is possible to synthesize ferromagnetic polymers.
- Demonstrate 15 volt, 5 watt miniaturization of all solid state battery for mini- Global Positioning System.

FY 1991 Planned Program:
- Develop on-line continuous process for producing piezoelectric polymer films for submarine, towed array and sonobuoy sensors.
- Demonstrate oxidation-resistant coatings of niobium intermetallics that can withstand temperatures up to 1540°C.
- Develop advanced activated carbon fibers for application in individual serviceman protection including gas masks with regenerable filters.
- Demonstrate Proton Exchange Membrane Fuel Cell Power System for utilization in DARPA's Unmanned Underwater Vehicle.

D. WORK PERFORMED BY: Lanxide Corporation, Newark, DE; University of Wisconsin, Madison, WI; Pratt and Whitney Aircraft Company, West Palm Beach, FL; GA Technologies, La Jolla, CA; Virginia Polytechnic Institute, Blacksburg, VA; International Fuel Cells Corp., South Windson, CT.

Program Element: #0601101E
PE Title: Defense Research Sciences
Project Number: MS-01
Budget Activity: 1. Technology Base

E. RELATED ACTIVITIES: DARPA's research in Materials Sciences is coordinated within the DoD and with other federal agencies via the NSF-hosted Interagency Materials Group, OSTP's Committee on Materials (COMAT), and various Director Defense Research and Engineering (DDR&E) sponsored topical workshops on advanced materials. These activities assure that no unnecessary duplication of effort occurs.

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
ST-01	Advanced Strategic Concepts and Technical Analysis				
	12,108	2,075	1,280	____	Continuing
ST-10	Strategic Computing				
	126,040	99,813	108,683	____	Continuing
ST-11	Intelligent Systems				
	27,556	36,430	34,159	____	Continuing
ST-12	Advanced Quantum Electro-Optics				
	16,452	10,167	19,165	____	Continuing
ST-13	Advanced Surveillance Concepts				
	6,947	0	0	____	Continuing
ST-15	ManTech				
	61,778	27,500	21,900	5,000	120,128
ST-16	High Temperature Superconductivity/Ceramics				
	25,232	27,878	22,562	-----	Continuing
ST-18	DARPA Initiative in Concurrent Engineering (DICE)				
	0	30,000	0	____	____
TOTAL FOR PROGRAM ELEMENT*					
	343,461	233,863	207,749		

*Totals include classified projects not identified herein

B. BRIEF DESCRIPTION OF ELEMENT: This program element funds exploratory development projects directed towards the 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.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

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

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
ST-01 Advanced Strategic Concepts and Technical Analysis	12,108	2,075	1,280	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: This project supports the JASONS, an independent group of distinguished physicists that provides analysis of important national security technical issues. Each JASONS member provides detailed evaluations of emerging technologies and assesses recent scientific discoveries for potential contributions to national defense.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
Conducted evaluations of the following technical issues:

- Verification Technology
- Anti-Submarine Warfare (ASW) Computer Architecture
- Ocean Backscatter Phenomena
- Advanced ASW Sensor
- Seismic Discrimination
- Structural acoustics
- Submarine Communications
- Electromagnetic Properties of Composites

FY 1990 Planned Program: Continuing evaluations of new technical issues as they arise.

FY 1991 Planned Program: Continuing evaluations.

Program to Completion: Continuous effort.

D. WORK PERFORMED BY: Mitre Corporation, Mclean, Virginia

E. RELATED ACTIVITIES: Not Applicable

F. OTHER APPROPRIATION FUNDS: Not Applicable

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not Applicable

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-10
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
ST-10 Strategic Computing	126,040	99,813	108,683	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: Developing a new generation of computing technology, with emphasis on artificial intelligence and high-performance computing. The basis for this revolutionary technology is recent advances in scalable parallel computing systems and microelectronics. Exploits advances in these areas by developing algorithms and software environments, access to common computing resources including new multiprocessor architectures, high-performance network communications for researchers, and systems standards. Military applications provide a realistic task environment for these new technologies as applied to command and control, planning and intelligence functions for aviation, naval and ground warfare.

C. PROGRAM ACCOMPLISHMENTS AND PLANS.

FY 1989 Accomplishments:

- Metal Oxide Semiconductor Implementation Service (MOSIS) now offers Gallium Arsenide (GaAs) integrated circuits (ICs), expanding on its successful support for silicon IC prototyping.
- Full prototype of the Capabilities Assessment Expert Systems (CASES) for Naval Command and Control.
- Near-real time demonstration of Pilot's Associate.
- Demonstrated automated AirLand Battle Management planning at the Corps and Division levels.
- Automated screening of broad area Synthetic Aperture Radar (SAR) imagery using parallel architectures.
- Software products integrated and tested for smart weapons.
- Integration of motion detection modules, terrain modeling modules, sensor fusion processes in machine vision.
- Demonstration of prototype second generation scalable parallel computer systems with sustained performance on large problems of 10 gigaops, including wideband opto-electronic 16 x 16 crossbar switch.
- Optical data links between parallel computers.
- Rapid prototyping of wafer-scale designs with capability to integrate tens of millions of transistors in a single silicon substrate.
- Experimental system technology modules to rapidly implement systems based on modular hardware and software.

FY 1990 Planned Program:

- New applications will be started, including Anti-Submarine Warfare (ASW) signal processing and additional military applications of artificial intelligence.
- Machine intelligence technologies using parallel computing will demonstrate performance approaching real time.
- Parallel architectures support transition of new generation machine intelligence technologies to applications.
- Demonstration of additional second-generation parallel computing systems with performance of at least 10 gigaops.

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

- Demonstration of additional advanced technologies such as wafer-scale VLSI designs, and parallel software synthesis.
- Development of large-scale speech-monitoring techniques for command and control and other applications.
- Demonstration of machine vision prototyping environment supporting accelerated development of image understanding systems.
- Initiate development of advanced image processing systems to meet defense high definition display requirements.

FY 1991 Planned Program:

- New generation vision system demonstrates the integration of motion detection modules, terrain modeling modules, sensor fusion processes in near-real time.
- Flexible planning and scheduling systems capable of rapid modification in resource constrained, dynamic applications.
- Real-time recognition of continuous speech with 1000-word vocabulary which can adapt rapidly to a new speaker.
- Image understanding environment providing accelerated tech transfer from research community to application development groups.
- Demonstrate a large-scale aerodynamic simulator prototype on a 10 gigaops scalable parallel computing system.
- Demonstrate a military application of high performance computing showing the potential impact of teraops computation.
- New applications in aviation, military command and control, planning, and intelligence.
- Computing systems capable of 100 billion operations per second.
- Scalable parallel computing systems combined to yield heterogeneous parallel computers.
- Experimental system technology modules rapidly implement systems based on modular hardware and software.
- Demonstration of technology for packaging one gigaops processor in 100 cubic inches.
- Demonstration of 200 megahertz gallium arsenide signal processor.
- Demonstration of prototype elements for high definition display image processing systems.

D. WORK PERFORMED BY: General Electric Corporation, Schenectady, NY; Bolt, Beranek and Newman, Cambridge, MA; Carnegie-Mellon University, Pittsburgh, PA; Stanford University , Palo Alto, CA; Intel Corporation, Santa Clara, CA; David Sarnoff Labs, Princeton, NJ; Texas Instruments, Dallas, TX.

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

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-11
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
ST-11 Intelligent Systems	27,556	36,430	34,159	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: Investigates sciences and technologies that promise fundamentally new intelligent information processing capabilities and related advanced software capabilities. This will enable computers to assist, advise, and/or relieve military personnel in complex tasks and leading decision-making, including those related to systems development and maintenance and in tasks that are tedious, dangerous, or rapidly changing. A major emphasis is rapid prototyping of next-generation computing systems for defense needs that are flexible, robust, and cost-effective. Major areas of technical emphasis include languages, algorithms, systems software, and design tools. The specific approach continues to be development of artificial intelligence (AI) systems and supporting technologies.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:

- Developed major experimental testbed for integrating a range of visual operations on complex images from a variety of scenes representative of military and manufacturing situations.
- Explored important issues for integrated machine perception: focus of attention - processing only relevant sensory data, and complex control strategies to manipulate objects in the images tested; multiple problem-solving paradigms to explore their performance and adaptability on difficult human tasks.
- Initiated design for very high level language and environment tools to support the rapid creation, analysis, and adaptation of prototype systems and components.
- Demonstrated improvements in use of formal analysis methods and tools to rigorously establish functionality properties for selected systems software components.
- Initiated development of advanced algorithms and algorithm design techniques to facilitate solutions to symbolic processing problems using parallel computing.

FY 1990 Planned Program:

- Demonstrate Ada environment architecture for specification and analysis in parallel systems.
- Develop a model for integration of speech and language processing that includes prosodic information such as stress and pitch, and demonstrate in an interactive spoken language system.
- Demonstrate effective processing of images using an integrated three-layer processing strategy implemented in hardware on an advanced multi-stage accelerator.
- Develop automatic task planning methods that will allow a robot to program itself, given a description of itself and its environment along with a model of objects which it manipulates.
- Develop design tools allowing capabilities to be realized flexibly in hardware or software as required for performance.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-11
Budget Activity: 1. Technology Base

FY 1991 Planned Program:

- Explore perception and cognition problems whose solution could revolutionize the Department of Defense (DoD) weapons and information systems in the future.
- Continue research in cooperative problem solving, reasoning with uncertainty, image understanding, knowledge-based system tool development, and natural language, using new computer architectures from Strategic Computing (ST-10) to increase functionality and performance.
- Develop advanced reasoning techniques to capture designs and automatically generate diagnostic and monitoring knowledge.
- Expanded subject domains in automated understanding of message text for data capture.
- Expanded area and scope capabilities of aerial image interpretation, integrated with terrain data bases.
- Develop software environments incorporating prototyping approaches and advanced analysis and optimization tools to support advanced software acquisition models based on reduction of risk and support for evolution throughout the software lifecycle.
- Demonstrate languages and systems software to support symbolic and numeric processing applications on high performance heterogeneous parallel systems, including network based systems.

D. WORK PERFORMED BY: Stanford University, Palo Alto, CA; University of Southern California, Information Sciences Institute, Marina del Ray, CA; Carnegie-Mellon University, Pittsburgh, PA; Harvard University, Cambridge, MA; Computational Logic, Incorporated, Austin, TX; University of California at Berkeley, CA; Rice University, Houston, TX.

E. RELATED ACTIVITIES: Program Element #0602301E, ST-10 Strategic Computing is based on machine intelligence research performed under this project.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-12
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
ST-12 Advanced Quantum Electro-Optics	16,452	10,167	19,165	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: The objective of the Advanced Quantum Electro-Optics program is to develop materials and devices to protect human eyes and sensors against broadband, frequency agile short-pulse laser threats projected to be deployed in the battlefield. Current Service programs address only fixed-line laser threats. The DARPA program has three major thrusts: 1.) develop nonlinear optical materials and devices for eye-sensor protection, including development of prototype devices, 2.) evaluation and field use of prototypes by troops, and 3.) medical treatment of laser-related eye injuries. Prototype devices will be developed to evaluate performance from materials that show promise of being able to meet protection goals.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Initiated nonlinear optical materials development for eye-sensor protection program.
- Initiated program to develop microlens arrays enhancing the effects of nonlinear materials.
- Initiated program to develop therapeutic and surgical treatment of laser-related eye injuries.
- Developed optical switching concepts for protection of infrared sensors.

FY 1990 Planned Program:
- Develop enhanced nonlinear optical materials with adequate performance for sensor protection against tunable lasers.
- Demonstrate the microlens array fabrication.
- Evaluate optical switching concepts for protection of infrared imaging systems.
- Develop therapeutic and microsurgical techniques to treat laser-related eye injuries.

FY 1991 Planned Program:
- Evaluate nonlinear materials for eye/sensor protection against pulsed tunable laser threats.
- Develop protection device design concept.
- Evaluate prototype optical switching devices for protection of infrared imaging systems.
- Demonstrate bonding of microlens arrays.

D. WORK PERFORMED BY: The major performers are Massachusetts Institute of Technology/Lincoln Laboratory, Lexington, MA; Boeing Aerospace, Seattle, WA; Rockwell Science Center, Thousand Oaks, CA; Lockheed Missile & Space Company, Palo Alto, CA; and Martin Marietta Company, Baltimore, MD.

E. RELATED ACTIVITIES: The Eye/Sensor protection program is coordinated with the Army Advanced Laser Protection Program through a Memorandum of Agreement (MOA) between US Army LABCOM and DARPA. The Army and DARPA technology programs complement and support each other.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-12
Budget Activity: 1. Technology Base

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-15
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
ST-15 Gallium Arsenide Applications	61,778	27,500	21,900	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: This project demonstrates the military advantages of digital gallium arsenide (GaAs) subsystems for upgrading fielded systems, including electronic countermeasures, surveillance, and intelligence systems. The DARPA efforts will result in prototypes that the relevant Service program offices have agreed to test, qualify, and procure as upgrades. Complementary efforts are establishing manufacturing capability for advanced digital GaAs and developing key components. The project also includes an effort to demonstrate the technology for conformal microwave transmit/receive (T/R) modules ("smart skins"). The project also included the DARPA Initiative in Concurrent Engineering (DICE) in FY 1989; this effort is now in ST-18.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Completed development of T/R cell and packaging.
- Establishment of the Concurrent Engineering Research Center.
- Draft definition of open architecture for DICE.
- Grew first non-linear optical organic crystals of usable size for wavelength doubling.
- Initiated digital GaAs insertions contracts.

FY 1990 Planned Program:
- Demonstrate GaAs processor for 8 times faster signal processing on RC-135 reconnaissance aircraft.
- Design GaAs signal processor for OH-58D upgrade.
- Demonstrate 200 megahertz GaAs central processing unit chip.
- Demonstrate complete T/R cells and packaging.

FY 1991 Planned Program:
- Demonstrate 7 times faster On-Board Processor based on GaAs for classified spacecraft.
- Demonstrate fieldable GaAs digital radio frequency memories to allow Army and Navy tactical aircraft to jam new class of threat radars.
- Demonstrate AN/PRC-126 small unit radio that is interoperable with Army standard radios.
- Demonstrate AN/APS-137 radar capable of double current resolution.
- Integrate T/R cells and packaging into 5 working subarrays.

D. WORK PERFORMED BY: Major contracts include E-Systems, Greenville, TX, and St. Petersburg, FL; Martin Marietta, Denver, CO, and Orlando, FL; Westinghouse, Baltimore, MD; Texas Instruments, Dallas, TX; Rockwell, Newbury Park, CA; and McDonnell Douglas, Huntington Beach, CA.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-15
Budget Activity: 1. Technology Base

E. RELATED ACTIVITIES: This project is the only effort to insert digital gallium arsenide technology into fielded military systems. The work is coordinated with Service research efforts through the Advisory Group on Electron Devices. These activities assure that no unnecessary duplication of effort occurs.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-16
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
ST-16 High Temperature Superconductivity/Ceramics	25,232	27,878	22,562	TBD	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This program involves processing, fabrication and demonstration of high temperature (transition temperatures, T_c, greater than 77 degrees Kelvin) ceramic superconductors (HTSC's) in thin films, wires, tapes and devices processed to achieve required critical current (J_c) carrying capability, magnetic properties, mechanical behavior and long term stability. Ultimate applications include Analog/Digital (A/D) converters, analog and digital devices, gyroscopes, accelerometers, motors, bearings, Superconducting Quantum Interference Devices (SQUIDS), magnets and energy storage, Radio Frequency (RF) cavities, antennas and Infrared (IR) sensors. Major attention is also given to manufacturing issues of reproducible quality and quantity.

C. PROGRAM ACCOMPLISHMENT AND PLANS:

FY 1989 Accomplishments:
- Evaluated 10 different processing approaches for varying HTSC parameters such as J_c and T_c.
- Produced HTSC thin films on inexpensive dielectric substrates at temperatures less than 600°C.
- Demonstrated an order of magnitude improvement in performance in microwave components fabricated out of HTSC materials.
- Repeatedly achieved current densities from 10^4-10^5 A/cm^2 in a magnetic field greater than 1 Tesla.

FY 1990 Planned Program:
- Organize several industrial consortia similar to SEMATECH to manufacture HTSC electronic components.
- Produce HTSC wire or monoliths with critical current density (J_c) of 10^5 A/cm^2 at 77°K.
- Joint demonstration of HTSC bearing technology with other DoD components for satellite applications.

FY 1991 Planned Program:
- Construct HTSC motor of 3hp or greater power.
- Demonstrate IR sensor with superconductor-based microbalometer.
- First demonstrations and prototypes of thin film electronics applications of superconductor technology, bulk development of generators and energy-storage devices for motors.
- Assess contributions of different consortia to DARPA program and prepare road map to chart projected deliverables and commercial advances for these efforts.

D. WORK PERFORMED BY: Major performers include: Superconductor Technologies, Inc. Goleta, CA; GA Technologies, La Jolla, CA; Massachusetts Institute of Technology, Cambridge, MA; University of California, Santa Barbara, CA; University of Houston, Houston, TX; Honeywell Corp., Minneapolis, MN; and Ceramic Process Systems, Milford, MA.

E. RELATED ACTIVITIES: Research on high temperature superconductors (HTSC) is coordinated within DoD and with other federal agencies via the OSTP Committee on Materials (COMAT), HTS Coordinating Committee, the NSF-hosted Interagency Materials Group, and numerous workshops involving industry, universities and government laboratories.

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-16
Budget Activity: 1. Technology Base

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATION AGREEMENTS: None.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
TT-03 Naval Warfare Technology	54,557	22,322	55,574	TBD	Continuing
TT-04 Armored Warfare Technology	14,123	13,000	10,000	TBD	Continuing
TT-05 Target Acquisition and Weapons Technology	45,906	28,287	29,838	TBD	Continuing
TT-06 Tactical Directed Energy Technology	10,137	15,075	14,601	TBD	Continuing
TT-07 Aeronautics Technology	0	10,932	11,522	TBD	Continuing
TT-08 Lighter Than Air Technology	29,383	30,000	0	0	59,383
Total for Program Element*	154,106	120,616	121,535		

*Total includes classified project 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; (3) to enhance ocean surveillance and anti-submarine warfare targeting and control technologies; (4) to produce effective and affordable aerospace weapon systems; and (5) to develop an airship testbed for sensor evaluation.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-03
Budget Activity: 1. Technology Base

A. RESOURCES ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
TT-03 Naval Warfare Technology	54,557	22,322	55,574	TBD	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES: The Naval Warfare project seeks to establish the technology base needed to maintain control of surface and sub-surface ocean areas in the face of performance advances by the Soviets. The program focus is on Anti-Submarine Warfare (ASW) and in particular the detection and targeting of the submarine threat.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:

- IAASW Technology: Investigated signal processing detection system concepts. Competitive designs for cost-optimized passive detection array. Validation of models.
- INAASW Technology: Conducted joint experiments with Norway and UK. Continued theoretical and lab studies of surface-wave phenomena.
- Torpedo Technology: Tested penetrators. Completed concept formulation; started advanced concepts design efforts.
- Demonstrated over-the-horizon (OTH) communications in a fleet exercise using a high-altitude transponder.

FY 1990 Planned Program:

- Acoustic ASW Technology: Demonstrate sonar lab system. Carry out at-sea experiment; continue development of acoustics technology including at-sea demonstrations aboard fleet submarines.

FY 1991 Planned Program:

- ASW Technology:
  - Continue development of methods: Major gains in sonar performance by acoustic signal recognition, classification and target localization will be demonstrated. A laboratory-based system is currently being tested with recorded at-sea data. Preparation for at-sea testing will be initiated with a redesigned system architecture.
  - Continue development of relocalization technology: Packaging, distributing, and monitoring system designs will be completed, leading to sea trials of a demonstration system.
  - Advanced methods will be used to demonstrate that range data can be obtained. Conduct sea trials of a focused system concept.
  - Complete acoustic signal detection demonstration. Complete design of an optimized signal processing system and demonstrate its performance at sea.
  - Select best source options and begin technology demonstration effort. The feasibility of sonar designs will be evaluated and demonstrated. Evaluate alternative source design methods and design a demonstration source for sea trials.

Program to Completion: Transition to the DARPA 6.3 demonstration effort. The balance is a continuing program.

D. WORK PERFORMED BY: Industry does 80% of the work and DoD in-house agencies do 20%. Contractors include: AT&T , Whippany , NJ; Bolt, Beranek and Newman, Inc., Arlington, VA and Cambridge, MA;

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-03
Budget Activity: 1. Technology Base

Martin Marietta, Baltimore, MD; Orincon Corporation, LaJolla, CA; Pacific-Sierra Research Corporation, Los Angeles, CA; Raytheon Company, Portsmouth, RI; Applied Physics Laboratory and Johns Hopkins University, Columbia, MD.

E. RELATED ACTIVITIES: Seismic Acoustic ASW: joint DARPA/Navy OP21.

F. OTHER APPROPRIATION FUNDS: None

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-04
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
TT-04 Armored Warfare Technology	14,123	13,000	10,000	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: The 1985 Defense Science Board (DSB) noted that the United States was behind and falling further behind in armor and anti-armor technology, and recommended DARPA lead a program to catch up, get ahead, and maintain a competitive modernization rate. DARPA has developed and tested munitions and armors that defeat projected Soviet technology. There is no evidence that the Soviet effort has slackened in this technical area, and some evidence that it has accelerated. Under this program element, applied research is being accomplished to develop better armor and protection systems, smart mines and countermine systems, electromagnetic (EM) guns, and anti-armor chemical energy (CE) and kinetic energy (KE) munitions.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Conducted ballistic analysis and tests of armors and CE and KE warheads.
- Enhanced technology base in areas such as armor penetration design code development, improved materials characterization and low cost processing techniques.
- Developed laboratory EM Guns firing at high muzzle energies of 7 MegaJoules.
- First realistic scaled tactical KE penetrators launched at 3.4 kilometers per second using laboratory EM Guns.
- Concept definition and design completed for brassboard smart controller for the Army Wide Area Mine, enabling a minefield to be remotely controlled. Also, definition and design completed for anti-helicopter mine. Transition agreement with Army formulated.
- Completed Phase I Countermine technology developments that show significant promise for improved detection techniques.
- Conducted advanced physics experiments using high power x-ray diagnostics to understand KE/CE penetration into confined ceramics and used the data to improve hydrocodes.

FY 1990 Planned Program:
- Continue research in armor advanced concepts for Heavy Force Modernization Block III and USMC light weight vehicle applications.
- Develop tailored explosives for advanced reactive armor.
- Test advanced heavy metal CE warheads for deep penetration.
- Demonstrate 9 MegaJoule EM guns with both plasma and solid armatures.
- Share in joint Army/DARPA development of skid-mounted 9.0 MegaJoule Electromagnetic (EM) range gun.
- Continue promising countermine technology programs and formulate Phase II plans.

FY 1991 Planned Program:
- Conduct performance enhancement of penetrators.
- Test advanced Chemical Energy (CE) concepts including robust jets insensitive to lateral loads, and ultra-fast jets (approximately 20 kilometers/sec) to defeat reactive armor.
- Continue work on new KE penetrator designs.
- Continue advanced modular armor concepts for HFM and light armor.
- Preliminary testing of countermine technology.
- Continue development of smart controllable anti-helicopter mine.

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-04
Budget Activity: 1. Technology Base

- Develop advanced pulse power sources and new EM Gun accelerator concepts.

D. WORK PERFORMED BY: The major performers are Los Alamos National Laboratory, Los Alamos, NM; Battelle Memorial Institute, Washington, DC; Lawrence Livermore National Laboratory, Livermore, CA; FMC, San Jose, CA; University of Texas, Austin, TX; California Research and Technology, Pleasanton, CA; Southwest Research Institute, San Antonio, TX; Science and Technology Associates; Rosslyn, VA; and Kaman Sciences, Colorado Springs, CO.

E. RELATED ACTIVITIES: The DARPA Joint Armor/Anti Armor Program is coordinated with the U.S. Army and marine Corps programs in this area. Other related DARPA programs are covered in EE-21 project Close Combat. Balanced Technology Initiative (BTI) funds also support Armor/Anti-Armor projects in DARPA such as Mine/Countermine and X-Rod Kinetic Energy Weapons. In addition, Nunn initiative funds are being applied in Armor/Anti-Armor.

F. OTHER APPROPRIATION FUNDS: None

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Programs to develop advanced reactive armors and integrated composite armor began in FY 1989. Major contractors for the advanced reactive armor are SNPE of France and Kaman of the United States. The programs are expected to take three years, with support divided between the United States and France. Major contractors for the integrated composite armor program are IBD of the Federal Republic of Germany and FMC Corporation of the United States. This armor development program is expected to last three years, with support divided between the United States and the Federal Republic of Germany.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-05
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
TT-05 Target Acquisition and Weapons Technology	45,906	28,287	29,838	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: This project develops sensors and processing for future tactical weapons systems. Current emphasis is on systems that will provide a conventional alternative to capability eliminated by the Intermediate Nuclear Forces (INF) treaty, and fill the gap in capability to locate and engage deep targets, artillery, and critical nodes. Applications to Low Intensity Conflicts and Special Operations are also developed.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:

- Demonstrated ability to predict most probable deployment areas of tactical ballistic missiles, multisensor capability and tracking methodology in the Tactical Use of National Technical Means Program.
- Determined most potent infrared sensing modes (active, passive, multicolor or combinations) for defeat of camouflage, concealment and deception in the Autonomous Infrared Sensor Program.
- Determined limits on automatic target recognition for various target classes and conditions in the Millimeter Wave Autonomous Sensor Program.
- Demonstration and delivery of low-cost, infrared optics applications using binary optics.
- Transitioned Uncooled Sensor Arrays to Service Seeker Development.
- Evaluated multisensor algorithms for Smart Weapons.

FY 1990 Planned Program:

- Demonstrate multisensor autonomous target acquisition and smart search in the Smart Weapons Program.
- Initiate multistatic radar development for brigade level Reconnaissance, Surveillance and Target Acquisition.
- Initiate program for family of Unattended Ground Sensors.
- Complete development of millimeter wave algorithms and transition sensor assets to joint service management.
- Initiate Advanced Sensor program to exploit powerful new sensor concepts.
- Demonstrate full video format focal plane arrays made from uncooled infrared sensors in brassboards and prototypes.
- Demonstrate a moderate cost, infrared objective/telescope and microlens array using binary optics.
- Formulate Advanced Technology Concepts for Organic Reconnaissance, Surveillance, and Target Acquisition; Special Operations; and Low-Intensity Conflict.

FY 1991 Planned Program:

- Demonstrate critical techniques for multistatic brigade level radar.
- Demonstrate multisensor Unattended Ground Sensor.
- Complete target data base for Follow-on-Force-Attack array, i.e. air defense units, tank columns, staging areas.
- Demonstrate Passive Synthetic Aperture Imaging System and "Thermal Imaging Eyeball."
- Complete automatic target recognition algorithms in the Millimeter Wave Autonomous Sensor Program. Seeker designs evaluated.

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-05
Budget Activity: 1. Technology Base

- Build and demonstrate sensors with imbedded computers for the Autonomous Infrared Sensor Program.
- Develop Advanced Technology Concepts for Special Operations Sensor Systems.

D. WORK PERFORMED BY: Honeywell, Boston, MA; Martin Marietta, Orlando, FL; Massachusetts Institute of Technology/Lincoln Laboratories, Lexington, MA; Texas Instruments, Dallas, TX.

E. RELATED ACTIVITIES: Program Element No: 0603226E, Project No. EE-30. Smart Weapons is an outgrowth of work in this project.

F. OTHER APPROPRIATION FUNDS: None

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-06
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
TT-06 Tactical Directed Energy Technology	10,137	15,075	14,601	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT:

The objective of the Tactical Directed Energy Technology Project is to develop moderate-power, efficient, high-brightness lasers, laser sensors, and modulated, medium-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, diode-pumped, solid-state lasers for tactical applications; (2) sensors for unattended measurement of treaty-restricted laser brightness; and (3) tunable microwave antenna development for advanced surveillance application as well as for negation and jamming of radar systems.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Completed the medium power solid-state laser technology base program and demonstrated high brightness laser at 100 watt average power in the green-wavelength.
- Continued development of advanced engineering models of hand-held lasers.
- Achieved a high repetition rate frequency modulated microwave radiation source.

FY 1990 Planned Program:
- Initiate program to develop sensors for unattended measurements of laser brightness.
- Initiate program for high-efficiency/high average power, diode-pumped solid-state lasers for tactical applications.
- Complete 1 gigawatt (GW) relativistic klystron development.
- Complete beat frequency effect testing for both "front door" and "back door" attacks.
- Initiate soliton microwave source development.
- Initiate modulated microwave radiation source effect testing of a surrogate monopulse radar.

FY 1991 Planned Program:
- Demonstrate efficient coupling of diode pumps to solid-state laser materials, high peak power/high pulse repetition frequency (PRF) operation of diode-pumped solid state lasers and efficient nonlinear conversion.
- Continue development of solid-state laser and nonlinear materials.
- Perform effect testing with the 1GW relativistic klystron source.
- Complete soliton microwave source and begin effect testing.

D. WORK PERFORMED BY: At present, major performers include Hughes Aircraft Company, El Segundo, CA; Physics International, Oakland, CA; Naval Research Laboratory, Washington, DC; and Science Research Laboratory, Somerville, MA.

E. RELATED ACTIVITIES: Plans for the Tactical Directed Energy Technology project are coordinated through frequent technical interchange meetings with representatives from the three Services' tactical directed energy programs. These arrangements ensure that no unnecessary duplication of effort occurs.

F. OTHER APPROPRIATION FUNDS: None

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-06
Budget Activity: 1. Technology Base

G. INTERNATIONAL COOPERATIVE AGREEMENTS: DARPA is also an active participant in the US-UK Information Exchange Program on laser and microwave weapon technology and effects.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-07
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
TT-07 Aeronautics Technology	7,342*	10,932	11,522	TBD	Continuing

* Funded in FY 1989 under Project TT-05, Program Element 0602702E

B. BRIEF DESCRIPTION OF PROJECT: As DoD attention swings sharply towards enhancing conventional defenses, the requirement to produce effective and affordable weapon systems becomes more and more important. The timely development of cost effective options and enabling technologies to satisfy this requirement is the objective of the Aeronautical Technology Project. This is accomplished through the exploitation of advances in avionics, propulsion, aerodynamics, and low observables to perform near-term options for performance enhancements and cost savings on new systems and retrofits of existing systems. The results of this project form the basis for future selection and development of affordable, conventional weapon systems that will greatly enhance our ability to perform both "battle management" and "battle execution" functions.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Planned Program:
- Assess the operational feasibility of the inherently low observable system.
- Fabricate/test nozzles.
- Preliminary design, critical component testing for low-cost cruise missiles.
- Trade studies of laser sound sensor techniques to detect terrain masked helicopters.

FY 1990 Planned Program:
- Investigate advanced sensor concepts (e.g., employment of high temperature semiconductors or electron tunneling phenomena).
- Evaluate systems for use in applications.
- Investigate advanced operational employment concepts (system architectures) for support of SOUTHCOM anti-drug activities.
- Complete the development of critical technologies that will enable a prototype demonstration of the system.
- Analyze alternative for vehicles.
- Investigate very small jet engine technology leading to bench tests of hardware in FY 1991.
- Develop technology for retrofit application or new platforms.

FY 1991 Planned Program:
- Flight test optical air data systems.
- Pursue technology development required for support of SOUTHCOM.
- Studies of innovative command, control, communications and intelligence (C^3I) and counter C^3I techniques.
- Fabricate and test very small jet engines suitable for off-board countermeasures vehicles (decoys/jammers).

Program to Completion:
- Fabrication/integration vehicle.
- Complete SOUTHCOM technology development and demonstrations.

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-07
Budget Activity: 1. Technology Base

D. WORK PERFORMED BY: AeroVironment, Inc., Monrovia, CA; Alcoa Defense Systems, Inc., San Diego, CA; David Taylor Research Center, Carderock, MD; Institute for Defense Analysis, Alexandria, VA; Naval Research Laboratory, Washington, DC; Leading Systems, Irvine, CA.

E. RELATED ACTIVITIES: None

F. OTHER APPROPRIATION FUNDS: None

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602707E
PE Title: Particle Beam Technology

Budget Activity: 1. Technology Base

A. RESOURCES ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
PB-01 Particle Beam Technology	14,000	14,000	14,500	TBD	Continuing

B. BRIEF DESCRIPTION OF ELEMENT:

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 with 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).

A key technological issue, stable propagation of single pulse, has already been demonstrated at short range. Range extension by means of multiple pulse propagation will be demonstrated in early 1990. In order to verify the energy scaling of propagation together with the feasibility of building a weapon within a size and weight of tactical interest, high energy compact accelerators must also be developed. Two different accelerator concepts are being pursued with a down-selection in FY 1992. Compact accelerator technology spin-offs will be encouraged and supported.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:

- Completed upgrade of the Advanced Test Accelerator (ATA) for the multiple pulse beam propagation experiment.
- Completed reconfiguration of the Radial Line Accelerator (RADLAC II) for the high current beam propagation experiment.
- Achieved 100% beam transport through the first acromatic bend of the Spiral Line Induction Accelerator (SLIA). Completed design of the SLIA prototype accelerator unit.

FY 1990 Planned Program:

- Conclude the multiple pulse experiment at ATA and the high current experiment at RADLAC II.
- Design, procure, and begin testing of the SLIA 10 kA injector and the first accelerator unit.
- Conduct 360° transport experiment with SLIA.
- Begin alternate development of compact accelerator using Ion Focused Regime (IFR) transport and complete a one turn experiment.
- Investigate advanced pulse power techniques for compact accelerators and other applications, e.g., wide-band radar, over-the-horizon radar and solid state pulser.

FY 1991 Planned Program:

- Conduct a proof-of-concept experiment on Spiral Line Induction Accelerator (SLIA) with a one-turn transport and acceleration.
- Continue the IFR compact accelerator experiment and conduct multiple-turn experiments.
- Develop fast switching pulse power technology.
- Develop high repetition rate 10 kA injector.

Program Element: #0602707E Budget Activity: 1. Technology Base
PE Title: Particle Beam Technology

- Continue investigations of advanced pulse power techniques.

D. WORK PERFORMED BY: The major participants are: Lawrence Livermore National Laboratory, Livermore, CA; Sandia National Laboratories, Albuquerque, NM; Naval Research Laboratory, Washington, DC; Science Applications International Corporation, Palo Alto, CA; and Pulse Science Inc., San Leandro, CA.

E. 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 charged particle beam efforts under the overall technical direction of DARPA. The Military Departments are responsible for advancing these technologies, which are essential in order to rapidly develop particle beam weapons once they are proven feasible.

F. OTHER APPROPRIATION FUNDS: None

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E Budget Activity: 1. Technology Base
PE Title: Integrated Command and Control Technology

A. RESOURCES ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
IC-01 Distributed Information Systems	18,521	16,734	19,403	TBD	Continuing
IC-02 Advanced Command, Control and Communications Technology	14,432	16,166	18,150	TBD	Continuing
IC-03 High Definition Display Technology (HDDT)		20,000			
TOTAL FOR PROGRAM ELEMENT	32,953	[illegible]0	37,553		

B. BRIEF DESCRIPTION OF ELEMENT: Develop and demonstrate technology under Distributed Information Systems for building systems that can fulfill Department of Defense (DoD) needs for information processing in DoD C3 applications. In the advanced command, control and communication technology project, development is aimed at secure, survivable, intelligent networks, utilizing advanced architectures and devices for controlling large-scale, high-performance secure communication networks for world wide command and control. Technology is transitioned into military application using large-scale networking/C3 testbeds.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

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

Project Number: IC-01
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
IC-01 Distributed Information Systems	18,521	16,734	19,403	N/A	Continuing

B. BRIEF DESCRIPTION OF PROJECT: Develop and demonstrate technology for building systems that can fulfill the Department of Defense (DoD) needs for information processing in command, control and communications (C3) applications. Development is aimed at distributed information systems which utilize advanced architectures and devices in large-scale, high-performance secure/survivable communications networks for world wide command and control.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:

- Initiated development of techniques to support policy-based routing at megabit data rates on the Internet as well as to move large amounts of priority ordered data.
- Demonstrated techniques for interoperability among C3 systems (including Open Systems Interconnection (OSI) standards) in testbed environments.
- Demonstrated object-based image communication techniques in a multi-media environment.
- Developed security requirements and architectures for Internet technology and experimental networks.
- Initiated development of new methods for network-based support of software systems.
- Initiated research into design of a network with links operating at rates of billions of bits per second (gigabits).
- Transferred SIMNET technology to the Army.

FY 1990 Planned Program:

- Demonstrate Trusted Mach, a multi-level secure Unix-compatible operating system for C3 systems of the 1990s.
- Demonstrate working distributed database systems in C3 testbeds.
- Develop a security architecture that allows use of existing and planned networking systems to act as secure communications systems.
- Develop distributed operating systems technology to support many thousands of processors.
- Demonstrate a national file system technology base capable of supporting shared access to information by hundreds of sites on high performance networks.
- Initiate a distributed wargaming testbed in the European Theater for interoperation of simulation models of various grain sizes and combat forces and demonstration of advanced C3 technologies.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

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

Project Number: IC-01
Budget Activity: 1. Technology Base

FY 1991 Planned Program:

- Transition the Internet to support OSI standard protocols.
- Demonstrate techniques for providing real-time data communication to support distributed command and control applications in an Internet environment.
- Develop mechanisms which permit integrated operation of very large distributed systems with thousands of nodes, using a design approach where the distributed nature of the system is transparent.
- Support software maintenance in the same mode.
- Develop aggregation algorithms for networking very large numbers of manned, semi-automated, and automated simulation for large-scale wargaming.

D. WORK PERFORMED BY: University of Southern California/Information Sciences Institute, Marina del Ray, CA; Bolt, Beranek and Newman, Cambridge, MA; Carnegie-Mellon University, Pittsburgh, PA; and University of California Los Angeles, CA.

E. RELATED ACTIVITIES: None.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

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

Project Number: IC-02
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
IC-02 Advanced Command, Control and Communications Technology					
	14,432	16,166	18,150	N/A	Continuing

B. BRIEF DESCRIPTION OF PROJECT: Developing and demonstrating technology for secure, survivable networks, utilizing advanced architectures and devices, for world-wide command and control.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Experimented with techniques for improving survivability and security, including design evaluations for Multiple Satellite System communication.
- Integrated capability for multimedia conferencing demonstrated in the Internet.
- Software systems for adaptive strategic planning will add maturing machine intelligence and user interface technologies.
- Implemented a new high-performance testbed for Internet policy-based routing experiments in cooperation with other federal agencies.
- Began phaseout of ARPANET low-speed networking testbed.

FY 1990 Planned Program:
- Begin development of third-generation tactical packet system prototype with megabit burst data rates.
- Demonstrate integrated security device in tactical packet system.
- Demonstrate multi-media interfaces in strategic C3 testbed.
- Demonstration of a digital packet network switch capable of performing policy routing (examining contents and enforcing pre-established communications policies) in networks operating at 45 megabits per second.
- Transition stable portion of high-speed Internet testbed to operation as DARPA-wide research infrastructure.
- Design upgrade of experimental portion of Internet to 45 megabits per second data rates.
- Initiate gigabit/second testbed.

FY 1991 Planned Program:
- A network management system for large-scale survivable networks will be developed and evaluated.
- Position location and end-to-end security capabilities will be integrated into the network.
- Gigabit network prototype components will be tested in laboratory configurations.
- Command and control experiments will be conducted to exercise a rapid adaptive strategic planning capability whose components are replicated and distributed to provide trans- and post-attack endurance.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

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

Project Number: IC-02
Budget Activity: 1. Technology Base

- A balanced set of advanced C3 technologies suited for defense requirements of the 21st century will be demonstrated in an integrated multi-service, multi-echelon testbeds combining simulation with actual combat forces.

D. WORK PERFORMED BY: University of Southern California/Information Sciences Institute, Marina del Ray, CA; Bolt, Beranek and Newman, Cambridge, MA; SRI International, Menlo Park, CA; Hazeltine Corporation, Greenlawn, NY; Harris Corporation, Melbourne, FL; and Rockwell-Collins, Dallas, TX.

E. RELATED ACTIVITIES: None.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E
PE Title: Materials/Electronic Technology

Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
MPT-01 Materials Processing	13,528	15,820	17,386	TBD	Continuing
MPT-02 Electronics Processing	11,316	10,500	12,700	TBD	Continuing
MPT-03 Optoelectronics/GaAs	12,500	0	13,010	TBD	Continuing
MPT-04 X-Ray Lithography	0	30,000	0		
TOTAL	37,344	56,320	43,096		

B. BRIEF DESCRIPTION OF ELEMENT: The objective of the Materials/Electronics Technology program element is to develop technology related to those materials and devices that make possible a wide range of new military capabilities. The Materials Processing project (MPT-01) focuses on the development of novel materials and processing routes to demonstrate advanced composites; strong, stiff ceramic fibers; applications of artificial intelligence and sensors to materials processing; and a metal matrix composite model factory to provide advanced aerospace structural materials. The Electronics Processing (MPT-02) project goal is to develop and implement next-generation electronic devices, circuits, and systems for military use including development of heterojunction devices, maskless processing for submicron structures, and advanced semiconductor manufacturing and applications. Under the Optoelectronics/GaAs project (MPT-03) an Optoelectronics Center including comprehensive programs in optoelectronics and photonics was initiated in FY 1989 to address the military needs in this area. X-ray lithography for defining semiconductor structures with 0.25 millimeter or better resolution is being developed under Project No. MPT-04. General program growth was reduced by $10.5M in FY 1990 for this Program Element. Some anticipated FY 1990 milestones have been cancelled or delayed into FY 1991. The planned programs in MPT-01 and MPT-02 are within approved budget levels.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

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

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
MPT-01 Materials Processing	13,528	15,820	17,386	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: The major goal of this program is to develop novel materials and processing routes for production of advanced composites and strong, stiff ceramic fibers. A major area of concentration is the application of artificial intelligence, sensors, and expert systems to materials processing and manufacturing.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Fabricated titanium-aluminum intermetallic compound matrix composites by rapid solidification plasma deposition.
- Evaluated strong, stiff high thermal conductivity metal matrix composites in actual propulsion systems.
- Designed and constructed test rig for evaluating ceramic composites in a gas turbine environment.

FY 1990 Planned Program:
- Determine whether or not ferroelastic domain switching is a viable mechanism for toughening ceramics.
- Demonstrate synthesis of ceramic composites by pyrolysis of a polymer precursor matrix.
- Demonstrate sensor viability and process model adequacy for powder consolidation by intelligent hot isostatic pressing.
- Establish a model metal matrix composite factory.

FY 1991 Planned Program:
- Optimize intelligent processing of thick section polymer matrix composites by using microwave curing and optical sensors.
- Evaluate ceramic composite components in a gas turbine engine environment.
- Demonstrate protective coating capabilities in intermetallic compounds for use in high temperature corrosive environments.
- Experimentally demonstrate theoretical predictions of vapor phase transport to coat carbon-carbon composites for oxidation protection.

D. WORK PERFORMED BY: Major performers are: United Technologies Research Center, East Hartford, CT; Martin Marietta Corporation, Baltimore, MD; General Electric Corporation, Schenectady, NY; Pratt and Whitney Corporation, West Palm Beach, FL; University of Virginia, Charlottesville, VA; and Sandia Laboratories, Livermore, CA.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E
PE Title: Materials/Electronics Technology

Project Number: MPT-01
Budget Activity: 1, Technology Base

E. RELATED ACTIVITIES: DARPA's research on Materials Processing is coordinated within the Department of Defense (DoD) and with other federal agencies via the National Science Foundation hosted Interagency Materials Group, Office of Science and Technology Policy Committee on Materials, and various Director Defense Research and Engineering (DDR&E) sponsored topical workshops on structural materials and materials processing. These activities assure that no unneccessary duplication of effort occurs.

F. OTHER APPROPRIATION FUNDS: Not Applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not Applicable.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E
PE Title: Materials/Electronic Technology
Project Number: MPT-02
Budget Activity: 1.Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
MPT-02 Electronics Processing	11,316	10,500	12,700	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: This project comprises development and implementation of future generation electronic and opto-electronic devices and circuits. Beginning in FY 1991, the emphasis in this project is on the development of advanced semiconductor processing equipment designed to reduce the cost of a wafer manufacturing facility by an order of magnitude. The advanced device efforts have been moved to Project No. MPT-03 for FY 1991 and beyond.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Demonstrated single-wafer processing in defect-controlled modules.
- Fabricated world-record low threshold surface-emitting laser diode.
- Developed non-spiking ohmic contacts to gallium arsenide (GaAs).
- Fabricated ring lasers operating without mirrors.
- Demonstrated a field-effect resonant tunneling transistor.

FY 1990 Planned Program:
- Fabricate and test a 4-kilobit ferroelectric non-volatile memory.
- Demonstrate Quantum Excited State Tunneling Transistor (QUESTT).
- Demonstrate high-speed optically addressed spatial light modulator.

FY 1991 Planned Program:
- Demonstrate the capability to conduct all necessary semiconductor fabrication steps in separate ultraclean modules rather than large clean rooms.
- Conduct 4000-gate-complexity manufacturing demonstrations using ultraclean modules.

D. WORK PERFORMED BY: Texas Instruments, Dallas, TX; McDonnell Douglas, Huntington Beach, CA; California Institute of Technology, Pasadena, CA; and Stanford University, Palo Alto, CA.

E. RELATED ACTIVITIES: The work is coordinated with Service research efforts through the Advisory Group on Electron Devices and via annual government-wide program reviews. These activities assure that no unnecessary duplication of effort occurs.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not Applicable.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E
PE Title: Materials/Electronics

Project Number: MPT-03
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
MPT-03 Optoelectronics/GaAs	12,500	0	13,010	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: This project's goal is to develop and implement next-generation and future generation electronic and opto-electronic devices and circuits. Emphasized are: quantum devices and circuits, non-volatile ferroelectric memory technology, advanced semiconductor processing, and optoelectronics. The efforts in FY 1991 and beyond were previously part of MPT-02. Accomplishments and FY 1990 planned program have been listed below as well as MPT-02 for continuity purposes.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Initiated selection of university Optoelectronics Center.
- Fabricated world-record low threshold surface-emitting laser diodes.
- Developed non-spiking ohmic contacts to gallium arsenide (GaAs).
- Fabricated ring lasers operating without mirrors.
- Demonstrated a field-effect resonant tunneling transistor.

FY 1990 Planned Program:
- Fabricate and test a 4-kilobit ferroelectric non-volatile memory.
- Demonstrate Quantum Excited State Tunneling Transistor (QUESTT).
- Demonstrate high-speed optically addressed spatial light modulator.

FY 1991 Planned Program:
- Demonstrate Integrated Circuit (IC) fabrication based on limited reaction processing.
- Demonstrate high-speed, non-volatile 16-kilobit ferroelectric memory on GaAs.
- Complete one-dimensional process modeling for GaAs heterostructures.
- Demonstrate optically controlled phased array subsystem.

FY 1992 Planned Program:
- Develop a 64-kilobit ferroelectric non-volatile memory.
- Demonstrate non-destructively read non-volatile ferroelectric memory cells.
- Establish the feasibility of new quantum-device-based circuit architectures.

D. WORK PERFORMED BY: Stanford University, Palo Alto, CA; Texas Instruments Incorporated, Dallas, TX; McDonnell Douglas Electronics Systems Company, Huntington Beach, CA; University of California, Santa Barbara, CA; Ortel Corporation, Alhambra, CA; Massachusetts Institute of Technology, Cambridge, MA.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E
PE Title: Materials/Electronics

Project Number: MPT-03
Budget Activity: 1. Technology Base

E. RELATED ACTIVITIES: Efforts in this project are coupled to the Services' programs through use of service agents, annual DoD-wide program reviews, and coordination through the Advisory Group on Electron Devices (AGED). These activities assure that no unnecessary duplication of efforts occurs.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not Applicable.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602714E
PE Title: Treaty Verification

Project Number: NM-01
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
NM-01 Treaty Verification	35,824	35,042	36,626	TBD	Continuing

B. BRIEF DESCRIPTION OF PROJECT: This program conducts research to enhance U.S. capabilities for monitoring world-wide nuclear explosions and provides technical support for U.S. participation in both bilateral and multilateral fora. The program also conducts research on methods for accurately detecting and characterizing radiation from nuclear sources. Better technical understanding is required to assess the technical value of data from nuclear explosions collected both on-site and at national technical means facilities and improved technical support to international cooperative verification activities and will incorporate the results from these activities into existing monitoring systems. This research program provides the required technical support to U.S. efforts in the Conference on Disarmament for the development and testing of an International Seismic Data Exchange System. Beginning in FY 1991, a new program will be initiated to examine basic technologies which may be used to improve the monitoring of other arms control treaties.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:

- Testing and evaluation of improved nuclear yield estimation techniques was carried out and incorporated into a usable system.
- Development began on a system incorporating artificial intelligence to receive and analyze the large volume of data from the network of advanced arrays and stations.
- The U.S. International Data Center was developed to support testing of the Conference on Disarmament global system.
- Final design of a complex imaging neutron detector array and an imaging, high-resolution gamma-ray detector was completed.

FY 1990 Planned Program:

- Improved advanced methods of yield estimation will be tested and applied over a range yields incorporating new data. Technical support to ongoing nuclear testing negotiations will be provided.
- The prototype intelligent array processing system will be initially tested and evaluation begun. This facility will be used for receipt and processing of advanced monitoring stations which are prototypes for future monitoring systems. Additional stations will be installed under the cooperative Eurasian Seismic Studies Program.
- Installation of a high-frequency array in the Federal Republic of Germany (FRG), in cooperation with the FRG, will be completed.
- Methods for deriving geophysical conditions at test sites from new digital space surveillance data will be examined.
- Final planning of the large-scale global test of the international monitoring system will be completed and testing of critical elements of this worldwide system will begin. Support will be provided for additional participants.

Program Element: #0602714E
PE Title: Treaty Verification
Project Number: NM-01
Budget Activity: 1. Technology Base

- Nuclear materials detectors will be tested against specific nuclear sources under realistic operating conditions.

FY 1991 Planned Program:

- The advanced signal processing system, including yield determination, will undergo testing and evaluation. Data from the international cooperative programs will be incorporated into the system.
- New methodologies for analysis of on-site measurements will be tested for yield determination using data collected under new treaty protocols.
- A large-scale test of a global monitoring system will be carried out under auspices of the Conference on Disarmament involving the U.S. International Data Center.
- Fundamental technologies on applying small-sample analysis, remote sensing methods, and radiation detection for monitoring purposes will be developed.
- Technical support will be provided to nuclear testing negotiations.

D. WORK PERFORMED BY: Approximately 66% of this work is performed by industrial contractors, 10% in-house laboratories, 7% foreign, and 17% university. Major performers include: Teledyne Geotech, Garland, TX; Science Applications International, San Diego, CA; University of Fla., Gainsville, FL; Mass. Institute of Technology, Cambridge, MA; Southern Methodist University, Dallas, TX; and Los Alamos National Laboratory, Los Alamos, NM.

E. 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. No duplication of effort is conducted.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Agreements with Norway and the Federal Republic of Germany call for joint activity in seismic arrays in that country. The UN Conference on Disarmament, with U.S. concurrence, has formally agreed on the large-scale global test of the international monitoring system in FY 1991.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
EE-17 Detection Of Aircraft (HI-CAMP)	1,399	0	0	0	10,399
EE-18 Advanced Undersea Vehicles	17,397	0	0	0	72,072
EE-21 Armor/Anti Armor Technolog	39,910	37,202	28,611	TBD	Continuing
EE-23 Enhanced Fighter Maneuverability Fighter	22,500	18,414	11,000	4,000	77,819
EE-24 Advanced Short Takeoff Vertical Landing	9,000	4,500	0	0	18,500
EE-25 Tactical Airborne Laser	22,059	22,000	0	0	66,938
EE-26 Hypersonic Weapons Technolog	25,625	22,144	16,000	TBD	Continuing
EE-27 Advanced Satellite Technology (Formerly LIGHTSAT)	34,000	35,000	29,442	TBD	Continuing
EE-30 Smart Weapons Application Program	1,000	0	10,500	TBD	Continuing
EE-31 Smart Mine Demonstration	0	2,250	0	0	2,250
EE-33 Cyclocrane	3,534	0	0	0	6,034
EE-34 Guidance Technology	0	5,450	13,400	TBD	Continuing

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Budget Activity: 2. Advanced Technology Development

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
EE-36 Target Detection	0	0	9,500	0	Continuing
TOTALS FOR PROGRAM ELEMENT	232,556	188,950	179,397		

*Total includes classified projects not identified herein.

B. PROGRAM ELEMENT DESCRIPTION: This program element is dedicated to the demonstration and evaluation of advanced research and development concepts.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-21
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Title: Close Combat (formerly Armor/Anti-Armor)

Popular Name	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
EE-21 Close Combat	39,910	37,202	28,611	70,845	201,349

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The 1985 Defense Science Board (DSB) noted that the United States was behind and falling further behind in armor and anti-armor technology, and recommended DARPA manage a Joint Program Office (JPO), with participation by the Army and Marine Corps to catch up, get ahead, and maintain a competitive modernization rate. In the JPO, DARPA has developed and tested munitions and armors that defeat projected 1995 technology threats, including better armors and protection systems and chemical and kinetic energy (CE and KE) munitions. Under this program element, technology developed under the JPO is being further developed, demonstrated, and transitioned to the Services. In addition, work is continuing in the maturation of technologies in electromagnetic guns, mine/countermine, smart guided weapon systems and fire control systems.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Continued "fast track" transition of promising CE warheads to upgrade fielded Anti-Tank Guided Missile (ATGM) systems.
- Performed ballistic analysis and testing of armors and CE and KE warheads.

FY 1990 Planned Program:
- Begin Phase II development of Chemical Energy (CE), armor protection, and continue transition of products to the Services.
- Begin investigations to define a 1998-2005 Close Combat threat.
- Develop and test armor candidates for improvements to fielded vehicles.
- Provide CE warheads for consideration in fielded ATGM upgrades.

FY 1991 Planned Program:
- Continuation of Phase II threat analysis and delivery of threat hardware.
- Perform final demonstrations of Chemical Energy (CE) and Kinetic (KE) warheads for Phase II and begin transition to Services.
- Pursue investigations of Phase II armors and CE warheads.
- Evaluate advanced KE penetrators.
- Test skid mounted (no umbilicals) 9.0 MegaJoule range electro-magnetic (EM) gun and launch of KE full-scale hypervelocity penetrators.
- Develop and fabricate smart, controllable anti-helicopter mine concepts.

Program to Completion:
- Develop and test advanced automatic target recognition system concepts for tactical armored targets in the presence of camouflage, concealment and deception.
- Define, develop and test concepts for autonomous weapons in the year 2000+ battlefield environment.
- Conduct prototyping and system integration.
- Continue development and research of advanced concepts.
- Demonstrate and test advanced smart, controllable wide area mines and anti-helicopter mines.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-21
Budget Activity: 2. Advanced Technology Development

D. WORK PERFORMED BY: The major performers are Los Alamos National Laboratory, Los Alamos, NM; Battelle Memorial Institute, Washington, D.C.; Livermore National Laboratory, Livermore, CA; FMC, San Jose, CA; University of Texas, Austin, TX; Aerojet Ordnance, Tustin, CA; Physics International, San Leandro, CA; Nuclear Metals, Inc., Concord, MA; ALCOA Defense Systems, ALCOA Center, PA; Honeywell, New Hope, MN; General Motors Military Vehicle, Indianapolis, IN; General Dynamics Land Systems, Warren, MI; General Electric, Pittsfield, MA; General Research Corporation, Santa Barbara, CA; Southwest Research Institute, San Antonio, TX; and Kaman Sciences, Colorado Springs, CO.

E. COMPARISON WITH FY 1990 DESCRIPTIVE SUMMARY: Not applicable

F. PROGRAM DOCUMENTATION: Not applicable

G. RELATED ACTIVITIES: This Armor/Anti-Armor program is coordinated with the U.S. Army and Marine Corps programs in this area. TT-04 is a related Close Combat Project. Balanced Technology Initiative (BTI) funds also support Armor/Anti-Armor projects such as Mine/Countermine and X-Rod Kinetic Energy Weapons. In addition, Nunn Initiative funds are also being applied in Armor/Anti-Armor. The work in guided weapons and smart mines for Armor/Anti-Armor is also related to EE-30.

H. OTHER APPROPRIATION FUNDS: None

I. INTERNATIONAL COOPERATIVE AGREEMENT: Two programs, a warhead program with the United Kingdom (UK) and major contractors for the warhead are Hunting engineering, Ltd., of the UK and Nuclear Metals, Inc., (NMI) of the United States.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EF-23
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Title: Enhanced Fighter Maneuverability

Popular Name	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
X-31	22,500	18,414	11,000	4,000	77,819

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT 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 maneuvers for close-in aerial combat. These results will provide critical design and performance data for assessing the utility and cost benefit of the FFM technology as applied to retrofiting existing fighter aircraft for integration into future fighter aircraft.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Completion of vehicle detailed design.
- Fabrication and assembly of X-31 No. 1 and No. 2.
- Initiation of aircraft ground testing for flight certification.
- Documentation of low-cost fabrication and assembly techniques for use by other programs.

FY 1990 Planned Program:
- Complete fabrication and assembly of X-31 No. 1 and No. 2.
- Initiate contractor flight test planning.
- Complete aircraft checkout for flight testing.
- First flight of X-31 Nos. 1 and 2.
- Envelope expansion flights.

FY 1991 Planned Program:
- Conventional envelope expansion flights.
- Initial post-stall (PST) maneuvering flights and PST envelope expansion.
- Initial Government pilot evaluation flights.

Program to Completion:
- Completion of DARPA-sponsored flight testing.
- Documentation of flight test results and transition to armed services for further user evaluation as necessary.

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

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-23
Budget Activity: 2. Advanced Technology Development

E. COMPARISON WITH FY 1990 DESCRIPTIVE SUMMARY: The reduction in total program funding requested from $80.9 M to $77.819 M results from a rebalancing of DARPA budget priorities. To accommodate this reduction, the two X-31 aircraft will remain at the Rockwell Palmdale, CA flight facility instead of moving to the Naval Air Test Center in Patuxent River, MD during 1991 as previously planned. In addition, the flight rate will be reduced to allow the program to continue into the first quarter of FY 1992 but will not allow previously planned tactical utility flight testing to take place. DARPA is attempting to secure additional funding from the Federal Republic of Germany and the U.S. Navy to allow completion of the flight test program as originally planned including tactical utility evaluations of the post-stall maneuvering technology.

F. PROGRAM DOCUMENTATION: None

G. RELATED ACTIVITIES:

- A U.S. Government Agility Steering Group has been established among DARPA, NASA, and 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-31 generated data on post-stall and other advanced maneuvering concepts.

- The X-29 High Angle of Attack Program is scheduled to start evaluating the performance of the X-29 at high angles of attack in FY 1990. This program will provide valuable data on the performance of the unique X-29 integrated technologies (forward swept wing, high degree of instability) in a high angle of attack environment. This data will complement X-31 generated data and will be a valuable contribution to the technology base vital for application of EFM concepts on current/future combat aircraft.

- Program Element 0603790D: NATO Research and Development Program funds FY 1986-1988.

H. OTHER APPROPRIATION FUNDS: Not applicable

I. INTERNATIONAL COOPERATIVE AGREEMENTS: The X-31 Enhanced Fighter Maneuverability (EFM) program is a joint program with the Federal Republic of Germany (FRG) initiated under the provisions of the Nunn-Quayle NATO Cooperative Research and Development Initiative. The program operates under a Memorandum of Agreement between DARPA and the German Federal Ministry of Defense. Messerschmitt-Bölkow-Blohm (MBB), as the German prime contractor, is tasked with development of the flight control system requirements, as well as design and fabrication of the wing and thrust vector vanes. German EFM studies occurred continuously from 1977 until 1986 when the X-31 program was initiated. The FRG investment up to that point was over $44M (US). This investment coupled with ongoing German participation in the program will bring their total financial participation to between 30 and 40 percent of the total program cost. This cooperative program is transferring significant technical data on post-stall maneuver and flight control to the U.S. industrial technology base.

J. MILESTONE SCHEDULE:

Plan	Milestones
MAR 1990	Rollout - X-31 No. 1
APR 1990	First Flight - X-31 No. 1
JUN 1990	First Flight-X-31 No. 2
OCT 1990	Initial Government Pilot Evaluations

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-23
Budget Activity: 2. Advanced Technology Development

Plan	Milestones
JAN 1991	Initial Post-Stall Maneuvering Flights
MAR 1991	Complete Conventional Envelope Expansion
DEC 1991	Submit Documentation of Flight Test Results

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-26
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Title: Hypersonic Weapon Technology

Popular Name	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
Hypersonic Weapon Technology (HWT)	25,625	22,144	16,000	TBD	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

The goal of the Hypersonic Weapons Technology (HWT) program is to identify and develop those enabling technologies required for implementation of a long range hypersonic weapons system. This includes the technologies required for the hypersonic delivery system (missile) with associated onboard sensors, guidance, control, materials, propulsion, submunition deployment, and fuzing. In addition, the critical technologies associated with other interfacing systems will be identified and developed. Typical of these systems are the launch platform(s), the long range surveillance and targeting, guidance and control, and C3I. This large spectrum of technologies cover a wide range of potential applications for precision prosecution of both airborne and ground targets. Mission applications currently being considered include long range air defense against cruise missile carriers and bombers for both ADI and the Naval Outer Air Battle (NOAB), suppression of Soviet defenses (anti-SuAWACS), and long range precision non-nuclear strike against fixed targets.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Initiate mission requirements analysis and trade studies with Navy and Air Force.
- Start an AXIS development program with two captive flights (CFT) of the AXIS array, and two free flights (FFT). The FFT-1 will be used to validate data from the CFT-1. The FFT-2 will be used to demonstrate close loop "strapdown" seeker guidance to intercept with AXIS.
- Start planning for captive test flight (CFT-1) with Lockheed and AFLC.
- Start SWERVE IV development. (FFT-1)

FY 1990 Planned Program:
- Continue developments initiated in FY 1989 for CTF-1 and FFT-1.
- Select advanced missile system design(s).
- Continue mission performance and tradeoff analyses to quantify system requirements.
- Perform trade studies to identify advanced technologies for incorporation into new sensor concepts for use on advanced hypersonic interceptor vehicles.
- Write Advanced Technology Development Plan (ATDP) to become annex to HWT MOA.

FY 1991 Planned Program:
- FFT-1 test planning and vehicle fabrication continue.
- Integration of AXIS into SR-71 for CFT-1.
- CFT-1 test and analysis.
- Integration of AXIS into SWERVE for FFT-1.

Program to Completion: This is a continuing program.

D. WORK PERFORMED BY: Sandia National Labs, Albuquerque, NM; Raytheon Corp., Bedford, MA; Texas Instrument Co., Dallas, TX; Martin Marietta Corp., Orlando, FL; Decision Science Applications, Arlington, VA.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-26
Budget Activity: 2. Advanced Technology Development

E. COMPARISON WITH FY 1990 DESCRIPTIVE SUMMARY: The MOA between DARPA, the Air Force, and the Navy was delayed as the milestones shown below reflect. The delay has provided a period of time in which to examine critical aspects of the SERVE/AXIS radar combination in more detail.

F. PROGRAM DOCUMENTATION: Not applicable

G. RELATED ACTIVITIES: None

H. OTHER APPROPRIATION FUNDS: None

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. MILESTONE SCHEDULE:

Plan	Milestones
Mar 90	Start advanced seeker concept technologies study.
Sep 90	Documentation of Advanced Technology Development Plan (ATDP) to become annex to MOA.
Oct 90	Complete integration of AXIS on SR-71 for CFT-1.
Dec 90-Mar 91	CFT-1 tests.
Aug 91	Integration of AXIS on SWERVE for FFT-1.
Oct 91	Initiate development of higher power T/R modules for CFT-2 and FFT-2.
Oct 92	FFT-1 of SWERVE IV with AXIS.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-27
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Title: Advanced Satellite Technology (LIGHTSAT)

Popular Name	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
LIGHTSAT	34,000	35,000	29,442	Continuing	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES: The Advanced Space Technology Program (ASTP) is a multi-disciplinary technology development aimed at fulfilling three goals: enhance the access to space and reduce the cost of space systems; decrease the vulnerabilities of space systems to natural phenomena and hostile actions; and improve the utility of space systems, especially to the tactical forces. The ATSP has four components. First, the development of enabling technologies, is receiving increased emphasis. The second is sponsorship of the initial launches of the Pegasus Air Launch Vehicle (ALV) for evaluation purposes. The third is the development and the demonstration of a Standard Small Launch Vehicle (SSLV). The fourth is the development and launch of experimental light satellites (LIGHTSATS).

The enabling technology work, which applies to enhancements for all types and sizes of spacecraft, is designed to examine state-of-the-art and emerging technologies in micro-electronics, optics, structures, superconductivity, microwave integrated circuits and other technologies. Various improvements in satellite subsystems and components will be undertaken including autonomous navigation; sensor and spacecraft control; submarine laser communications; VHF, SHF and EHF communications; tactical surveillance; advanced computer processors and Mass Memory Storage; lightweight components; unique power sources; integrated solid state optical data buses; and meterological and ocean surveillance technologies.

The launch vehicle efforts are aimed at developing cost-effective means for smaller satellite launches. The first two launches of the privately-developed Pegasus ALV are sponsored by Defense Advanced Research Projects Agency (DARPA) for evaluation as a mobile launch capability and orbiting of LIGHTSAT payloads. DARPA has let a contract for the demonstration and evaluation of a completely transportable SSLV which will be capable of placing up to 1,000 lbs in polar orbit.

Nine LIGHTSAT payloads are to be placed in orbit in FY 1990 to demonstrate various applications and provide a testbed for experiments by the Services. Two MACSAT, store and forward UHF communications LIGHTSATS and will be launched on a Scout ELV. Seven MICROSAT, UHF communciations relay LIGHTSATS will be launched on the second Pegasus ALV Launch. DARPA, with service support, is sponsoring a series of field demonstrations involving these LIGHTSATS.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:

- Launch and evaluate the first SSLV.
- Evaluate LIGHTSAT Payloads.
- Award contracts for technology developments for satellite systems, subsystems, and components.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-27
Budget Activity: 2. Advanced Technology Development

FY 1990 Planned Program:

- Transition UHF LIGHTSATS to users.
- Transition PEGASUS ALV to USAF.
- Continue technology development.

FY 1991 Planned Program:

- Expand technology developments with additional emphasis on those technologies that have broad applicability to all space systems to include technologies for:
  - Reducing cost by providing automated fabrication, processing and quality control.
  - Providing unique power generation.
  - Providing new propulsion techniques.
  - Networking of existing and future satellite systems to maximize utilization of data collection and dissemination and to provide robust and proliferated satellite control functions.
  - Improving survivability by both passive and active means.
- Integrate advanced EHF communications technologies for demonstration and evaluation.
- Transition SSLV effort to USAF.

Program to Completion:

- Continue expanded technologies developments and demonstrations.
- Transition technologies to services.

D. WORK PERFORMED BY: Orbital Sciences Corp., VA; Hercules, UT; Defense Systems Inc., Space Data Corporations, Space Applications Corporation. Multiple technology contractors to be announced after contract awards.

E. COMPARISON WITH FY 1990 DESCRIPTIVE SUMMARY: The program is being expanded to encompass advanced technologies for application to all space systems for reducing cost, improving survivability and increasing utility.

F. PROGRAM DOCUMENTATION:

- USAF/DARPA MOA dated 14 Nov 88
- U.S. Navy/DARPA MOA dated 13 Dec 88
- U.S. Army MOA (Draft)

G. RELATED ACTIVITIES: DARPA and the Air Force have entered into an MOA on the ASTP in which DARPA will manage and direct the joint program and provide primary funding. The Air Force will serve as DARPA's principal executing agent. MOAs establishing joint ASTP activities with the Army and Navy are pending. An existing Navy/DARPA MOA calls for Advanced Space Technology Launches in Support of the Navy SPINSAT and DARPA LIGHTSAT demonstrations. The Navy will launch two DARPA UHF satellites on a SCOUT vehicle and a NAVY Altimeter SPINSAT incorporating DARPA-developed GPS chip sets on another SCOUT vehicle. The first SSLV demonstration launch will include a satellite payload developed by the Air Force Space Technology Center. Close coordination with the Military Services will be called for in all Military Service agreements and there is no unnecessary duplication of effort within the Services, DARPA, or the Department of Defense.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-27
Budget Activity: 2. Advanced Technology Development

H. OTHER APPROPRIATIONS: None

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. MILESTONE SCHEDULE:

Plan/(Actual)	Milestone
(Sep 89)	Award of first BAA contract for technology development
Jan 90	Complete BAA Awards for Technology Development
Jan 90	Launch/Evaluation of air launched vehicle
Mar 90	Launch of two UHF satellites
Oct 90	RFP's/BAA for advanced technologies applicable to all space systems
Apr 91	Award contracts for advanced technologies
Winter 92	First Launch of SSLV

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-30
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
EE-30 Smart Weapons	1,000	0	10,500	60,000*	112,456

*Consolidation of EE-31 into this project

B. BRIEF DESCRIPTION OF PROJECT:

This project demonstrates autonomous weapons concepts that, when fielded, will offset the numerical superiority of Warsaw Pact tactical forces, and provide worldwide non-nuclear options to deep and follow-on-force-attacks. It integrates advancements in computing, guidance, automatic target acquisition, multisensor fusion, and warhead/munitions lethality. All classes of important tactical land targets, including those that employ camouflage, concealment, and deception techniques will be addressed.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Design of demonstration smart weapon system architecture.
- Selection of specific algorithms, techniques and hardware elements.

FY 1990 Planned Program:
- Development of demonstration system hardware.
- Preparation of demonstration test plan.
- Demonstration of automatic target recognition and smart search algorithms in field test.
- MOU with Army accomplished.

FY 1991 Planned Program:
- Begin fabrication of demonstration system.
- Complete evaluation of brassboard design for integration onto airframe.
- Computer hardware delivered, 1 GFLOP throughput in 60 cubic inches.
- Demonstrate smart search algorithms.

D. WORK PERFORMED BY: Northrop, Hawthorne, CA; Lockheed ASC, Marietta, GA; General Dynamics, Pomona, CA; Texas Instruments, Dallas, TX.

E. RELATED ACTIVITIES: Program Element 0602702E/TT-05 Target Acquisition and Weapons Technology .

F. OTHER APPROPRIATION FUNDS: None

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not Applicable

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-34
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
EE-34 Precision Guidance Technology	3,360*	5,450	13,500	Continuing	TBD

* Funded out of project ST-01, PE0602301E

B. BRIEF DESCRIPTION OF PROJECT: This program develops small, modular, low-cost, lightweight precision guidance technologies for long-range conventional strike weapon and guided munitions applications. The goal of this program is to establish the technical components from which near-"Zero-Circular Error Probable" weapons can be developed. Those weapon guidance technologies are necessary for effective target elimination with minimal collateral damage. Potential programs that could be impacted include the Long Range Conventional Stand-off Weapon (LRCSW) and TACIT RAINBOW. Specific research areas include low-cost, high-precision navigation/guidance, advanced radar-based terminal guidance, low-cost solid-state gyro-based munitions guidance and forward-looking-radar target correlation guidance.

The program's primary effort this fiscal year is to continue the development of small, modular, low-cost, lightweight navigation-grade (i.e., <0.01 deg/hr bias stability) inertial technologies. After development, these technologies will be incorporated into a modular integrated-navigation brassboard for evaluation. By exploiting the recent technical advances in miniature Global Positioning System (GPS) Receivers (MGR) and Fiber Optic Gyroscopes (FOG), a small, high-quality navigation unit should be producible at potentially low cost. For example, a 20-meter CEP MGR/FOG-based system with a <1 nm/hr bias stability will cost less than $15K/unit, weigh less than 10 pounds, use less than 20 watts of prime power, and be less than 200 in^3 in volume. In contrast, a similarly performing system composed of a Honeywell 1342 ring laser gyro, a Rockwell analog GPS receiver and a Modular Azimuth Positioning System (MAPS) strap-down accelerometer will cost around $65K/unit, weighs 65 pounds, consumes 160 watts of power, and fits within a 1800 in^3.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Demonstration of the first 100 cubic-centimeter size GPS receiver. Receiver technology transitions to Tactical Land Attack Missile; Wright Research and Development Laboratory Advanced GPS Receiver; Office of Naval Research Single Purpose Satellite (SPINSAT); Advanced Satellite Technology Program; and other government-sponsored efforts.

FY 1990 Planned Program:
- Design Interferometric Fiber Optic Gyroscopes (IFOG) and MGR breadboards for incorporation into a flyable navigation brassboard.

FY 1991 Planned Program:
- Fabricate, test, and characterize the IFOG and MGR breadboards.

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-34
Budget Activity: 2. Advanced Technology Development

- Mate IFOG and MGR units with a microprocessor, and test in integrated mode.
- Conduct flyable navigation brassboard Critical Design Review.
- Begin system software development and demonstration of forward-looking synthetic aperture radar (Emulation).
- Munition-guidance inertial measurement unit definition.

Program to Completion:

- Conduct navigation brassboard Preliminary Design Review.
- Begin new narrowband optical-gyro light source development for a Resonant Fiber Optic Gyroscope.
- Complete the development of a flyable navigation brassboard using a miniature GPS receiver mated with an interferometric fiber optic gyroscope-based IMU having a 1 nm/hr grade of performance.
- Fabricate Resonant Fiber Optic Gyroscope (RFOG) unit using the new narrowband light source.
- User-unique system analysis and associated software module development for flyable navigation brassboard.
- Complete fabrication and test the flyable navigation brassboard; begin ADM development with Service transition partner.
- Demonstrate a 1 nm/hr RFOG.

D. WORK PERFORMED BY: MIT Lincoln Laboratory, Boston, MA; Charles Stark Draper Laboratory, Boston, MA; and two navigation brassboard contractors.

E. COMPARISON WITH FY 1990 DESCRIPTIVE SUMMARY: The increase in the FY 1991 estimate is the result of plans to initiate system software development of the forward-looking synthetic aperture radar and munition-guidance inertial measurement unit definitions.

F. PROGRAM DOCUMENTATION: None.

G. RELATED ACTIVITIES: None. The Air Force Wright Research and Development Laboratory (WRDL) is contributing $1.3M to the narrowband laser source and Resonant Fiber Optic Gyroscope demonstration work.

H. OTHER APPROPRIATION FUNDS: None.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. MILESTONE SCHEDULE:

Mar 90	Phase I navigation brassboard contracts awarded.
Oct 90	Phase I navigation brassboard Preliminary Design Review.
Sep 90	Begin RFOG demonstration work.
Jul 91	Contract Award of Forward-looking Synthetic Aperture Radar (SAR) (emulation).
Oct 91	Phase I navigation brassboard Contract Design Review.
Nov 92	Advanced Radar Correlation (ARC) Feasibility Study contract award.
Jan 93	1 nm/hr RFOG demonstrated.
May 93	Navigation brassboards delivered.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-34
Budget Activity: 2. Advanced Technology Development

J. MILESTONE SCHEDULE:

Oct 93	Brassboard laboratory tests completed.
Dec 93	Radar Correlation Algorithm demonstrated.
Jan 94	Navigation Brassboard Final Report delivered.
Dec 94	Brassboard Flight Tests completed.
Aug 95	Real-time Forwarding-looking SAR Flight Demonstration.
Sep 95	ARC Subscale Flight Demonstration.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-36
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Title: Target Detection

Popular Name	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
EE-36 Target Detection	0	0	9,500	99,000	108,491

B. BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES:

This technology is being developed in the Naval Warfare Project of PE0602702E and will be picked up in this program in FY 1991. Specific technologies transitioned include air launched active sources and acoustic ASW processing. Trends in Soviet submarine quieting and hardening imperil U.S. capability for detection, localization, targeting and kill. This demonstration program has two objectives: 1) Apply advanced computer hardware and algorithms to radically improve the performance of extant and future sonar systems and to develop a system which will demonstrate those improvements. The system will also provide increased sensitivity and capability for localization and tracking for quiet targets. 2) To develop an airborne system that can rapidly and autonomously reacquire and localize submarines using cues. All ASW-related Naval missions will be impacted by these capabilities. The acoustic processing system will exploit and should significantly enhance existing passive acoustic sensor system capability for unalerted detection. The airborne relocalization system will provide immediate and extremely precise localization information that will support the use of air-launched ASW weapons. These weapons can be designed because less weight will have to be devoted to propulsion and acquisition systems. The processing system will be demonstrated at-sea using an appropriate surface or submarine platform. This system will address issues relevant to all navy sonars and has such will have excellent transition potential. The airborne relocalization system will be installed on a Navy ASW aircraft (a P-3 or S-3) for at-sea operational demonstrations. It will find application in both manned platforms and unmanned platforms such as UAV's and missiles.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Program: Basic technology funded in Naval Warfare Project TT-03; PE0602702E.

FY 1990 Program: Basic technology funded in Naval Warfare Project TT-03; PE0602702E.

FY 1991 Planned Program:

- 1) During FY 1991, several acoustic surveillance technology demonstration efforts will mature to a point where the feasibility of an integrated system prototype will be established. An Integration Contractor for the prototype will be competitively selected and one or more target platforms for an at-sea demonstration selected. The Integration Contractor will also be tasked to develop an integration facility where the prototype components can be further developed, integrated and tested with simulated and recorded data from sensors on naval platforms, taken during exercises of opportunity. This year will be devoted to preparation for intensive system development and laboratory evaluation during FY 1992 and FY 1993. As appropriate, the contractors responsible for the previous individual technology developments will be funded to support this demonstration project.

Program to Completion:

- Selection and initiation of construction for hardware to be demonstrated.
- Development and integration testing of the acoustic system .
- Navy to designate a suitable platform for demonstration under realistic operational conditions.
- Processing hardware will be mated with the demonstration platform and shakedown trials at sea.

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-36
Budget Activity: 2. Advanced Technology Development

- Operational capability demonstrations completed and the technology transitioned to the Navy to support Full-Scale Engineering Development.

D. WORK PERFORMED BY:

The Acoustic Demonstration Contractor will be competitively selected. Potential subcontractors include Martin Marietta Aerospace, Honeywell, American Telephone and Telegraph Technologies, Orincon and ESL. The contractors for the Airborne relocalization system will be competitively selected.

E. COMPARISON WITH FY 1990 DESCRIPTIVE SUMMARY: Not Applicable

F. PROGRAM DOCUMENTATION: Not Applicable

G. RELATED ACTIVITIES:

Office of Naval Technology Programs in sonar automation are addressing selected technology issues. Programs are and will continue to be coordinated.

H. OTHER APPROPRIATION FUNDS: None

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. MILESTONE SCHEDULE:

Plan	Milestones
JAN 91	Award demonstration contract.
MAR91	Award demonstration support contracts.
JUN 91	Select demonstration platform.
OCT 91	Award development contract for relocalization system.
MAR 92	Hardware design complete for both systems.
JUN 92	Acoustic system integration begins.
MAR 93	Acoustic system integration complete.
JUN 93	Demonstration hardware complete for both systems.
OCT 93	System demonstration platform designated.
JUN 94	Shakedown trials begin.
OCT 94	Operational demonstrations begin.
MAR 95	Operational demonstrations complete.
JUN 95	Transition to Navy complete.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603227E
PE Title: Relocatable Target Detection Technology

Project Number: RT-01
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Title: Relocatable Target Detection Technology

Popular Name	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
Relocatable Targets	12,266	19,000	22,702	TBD	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This DARPA program is dedicated to advanced experimentation and analysis to develop means of detecting and targeting mobile ground targets that take advantage of natural cover. The detection technologies apply to both tactical and strategic targets, however the emphasis is placed on mobile, land-based ICBMs such as the SS-24 and SS-25.

To hold mobile, concealed targets at risk, sensor and processing technologies must be able to extract a target signature from a heavily cluttered background. This selection of an exploitable signature requires a thorough understanding of how these targets are employed in their operational environment. To direct a weapon system against these targets, they must be detected through unique signatures against the background and 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 1989 Accomplishments:

- The MIT/LL effort will conduct extensive flight testing of developmental sensors against targets in clutter. 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.
- Additional systems effectiveness analysis will be conducted to incorporate detailed sensor technical data.

FY 1990/1991 Planned Program:

- The MIT/LL series of flight tests will come to an end, although analysis will continue. This analysis will be extended to other categories of relocatable targets.
- Where possible, methods will also be integrated into this advanced sensor technology demonstration. This demonstration will be used to make a decision on an advanced sensor prototype in mid-1991.

Program to Completion: The remainder of the program is planned to build, test, and evaluate alternative advanced sensor systems for the detection and classification of relocatable targets.

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

E. COMPARISON WITH FY 1990 DESCRIPTIVE SUMMARY: Not Applicable

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603227E
PE Title: Relocatable Target Detection Technology

Project Number: RT-01
Budget Activity: 2. Advanced Technology Development

F. PROGRAM DOCUMENTATION: NSDD 178, 7/85; SAC SON 001-85, 4/87; RT Master Plan, 9/87

G. RELATED ACTIVITIES: This program is overseen directly by a Department of Defense Steering Committee consisting of representatives from the Navy, Air Force, Intelligence Community, Joint Chiefs of Staff, Office of the Secretary of Defense, and Defense Advanced Research Projects Agency. Through the oversight, duplication is avoided in related programs such as the Air Force Relocatable Target Capability Program. The Air Force RT program is focused on near-term operational capability against RTs, while the DARPA program is directed at more robust long-term solutions.

H. OTHER APPROPRIATION FUNDS: None

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. MILESTONE SCHEDULE:

Plan	Milestones
MAY 1990	Algorithm Development Evaluation Report.
SEP 1990	Flight Verification.
JAN 1991	Multi-spectral flight demonstration.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603706E
PE Title: Microwave/Millimeter Monolithic Integrated Circuits (MIMIC)

Project Number: MM-01
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Title: Microwave/Millimeter Wave Monolithic Integrated Circuits

Popular Name	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
MIMIC	65,827	78,185	86,657	TBD	TBD

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:
This Program Element provides for a major Defense Advanced Research Projects Agency (DARPA)/Tri-Service effort to accelerate the development, manufacturing and demonstration of affordable microwave and millimeter wave analog integrated circuits (IC's). The MIMIC Program was transferred to DARPA in October 1988. This program will provide capabilities to correct Commander-in-Chief (CINC) identified operational deficiencies for Tactical Land Warfare, Air Warfare, Naval Warfare, and defense-wide Command/Control/Communications (C3). Its primary thrust is to develop affordable circuits operating in the 1 to 100 GHz frequency range with required characteristics and in sufficient quantity to satisfy military systems needs. The use of reliable and maintainable semiconductor devices and circuits for selected system demonstrations will be accelerated and, thus, provide the U.S. with a technological lead in deploying MIMIC-based military systems. Equipment and software developments, such as E-beam direct write lithography, automatic test equipment, computer-aided design/computer-aided manufacturing/computer aided test (CAD/CAM/CAT) will be accomplished as needed.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Continued Material/Technology Development contracts; first hardware and software (CAD) tools produced; first insertion into production system.
- Continued technology support efforts in E-beam lithography, and material/device correlation areas.
- Integrated above efforts with primary Material/Technology Development contracts.
- Initiated other technology support efforts in the areas of automated testing techniques, non-linear device and circuit modeling, improved material growth techniques, multichip packages, and novel processing techniques.

FY 1990 Planned Program:
- Complete MIMICs on 1000 wafers (minimum) per contractor team.
- Continue CAD development, processing enhancements, and manufacturing techniques.
- Complete package development.
- Demonstrate brassboards.

FY 1991 Planned Program:
- Deliver all test fixtures, chips, modules, and brassboards from first MIMIC hardware development phase.
- Complete Phase 1 CAD system development.
- Demonstrate MIMIC product usefulness for many systems (module and brassboard demonstrations.)
- Qualify chip production facilities to military standards.
- Produce chips for all DoD customers/contractors in MIMIC foundries.
- Deliver final test, reliability and QA plans and test results.

Program Element: #0603706E
PE Title: Microwave/Millimeter Monolithic Integrated Circuits (MIMIC)

Project Number: MM-01
Budget Activity: 2. Advanced Technology Development

- Deliver final technical reports, data and business plans.
- Complete E-beam enhancement program.
- For GaAs material technology support programs:
- Demonstrate a reliable capability for producing low defect, highly reproducible MBE material via improved instrumentation including real-time growth rate monitoring.
- Demonstrate availability of large capacity MOCVD reactors.
- For CAD and device modelling technology support programs:
- Demonstrate improved simulation tools and techniques and layout optimization for MIMICs.
- Demonstrate device design optimization through development of an RF sensitivity and process yield model that can interface with current large signal GaAs MESFET models.
- For multi-chip packaging technology support program:
- Demonstrate advanced multi-chip ceramic packages for production MIMICs.
- Establish a U.S. commercial package vendor.
- For automated testing techniques technology support programs:
- Continue development of noncontacting electro-optic probing equipment for MIMIC substrates and active layers.
- Demonstrate equipment , test methods, and software to perform automated pulsed testing of wafers containing "high Power" MIMICs.
- Transition advanced GaAs, design capabilities, packages and testing techniques to all DoD contractors.

Program to Completion:

- Initiate Advanced Technology and System Demonstrations during 1st quarter FY 1992.
- Provide support to solve technology problems and implement new material concepts and processes (as needed).
- Assure availability of MIMIC products through foundries and merchant suppliers.

D. WORK PERFORMED BY: In-house work, including management and support of MIMIC contractual efforts, will be performed by: Defense Advanced Research Projects Agency (DARPA); Department of the Army, U.S. Army Laboratory Command Electronics Technology & Devices Laboratory; Department of the Navy, Office of Assistant Secretary (Research, Engineering and Systems), Naval Air Systems Command, U.S. Naval Research Laboratory; Department of the Air Force, Wright Research & Development Center, Rome Air Development Center.

Material/development phase prime contractors are: Hughes/General Electric (El Segundo, CA/Syracuse, NY); Martin Marietta/ITT (Orlando, FL, Roanoke, VA); Raytheon/Texas Instruments (Bedford, MA/Dallas, TX); and TRW (Redondo Beach, CA). Technology support prime contractors are AT&T (Princeton, NJ); Ball (Boulder, CO); Comsat (Clarksburg, MD); Gateway Modeling (Minneapolis, MN); ITT Avionics (Nutley, NJ); M/A Com (Lowell, MA); NCSU (Raleigh, NC); Spire (Bedford, MA); TRW (Redondo Beach, CA); University of Colorado, (Boulder, CO); Varian Molecular Epitaxy Operation (Santa Clara, CA); and Varian Research Center (Palo Alto, CA).

E. COMPARISON WITH FY 1990/1991 DESCRIPTIVE SUMMARY: Not applicable. Consistent with FY 1990 Descriptive Summary.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603706E
PE Title: Microwave/Millimeter Monolithic Integrated Circuits (MIMIC)

Project Number: MM-01
Budget Activity: 2. Advanced Technology Development

F. PROGRAM DOCUMENTATION:

- Management Structure for the MIMIC Program, 9/85
- Program Plan for MIMIC, 5/86
- Acquisition Plan No. DoD 86-x for Mimic Program, 10/86
- MIMIC Program Security Classification Guide, DoD Instruction 5210.80, 8/87
- Acquisition Plan No. DoD 87-X for MIMIC Program, 10/87

G. RELATED ACTIVITIES: Exploratory and Advanced Development of gallium arsenide monolithic components are being undertaken with Army, Navy, Air Force, Defense Advanced Research Projects Agency (DARPA), and Strategic Defense Initiative Office (SDIO) program elements.

The related program elements and title are:

- Program Element #62705A, Electron Devices
- Program Element #63742N, Advanced Electron Devices
- Program Element #62234N, RF, Microwave, Millimeter Wave Materials, and Devices
- Program Element #62204F, Microwave Technology
- Program Element #63203F, Advanced Devices
- Program Element #62702F, Devices and Components
- Program Element #63220C, Strategic Defense Initiative-Large Array Technology
- Program Element #62301E, X-Bank Monolithic Circuit Technology for T/R Modules

The work performed under Program Element #0603706E is complementary to the work performed in the above program elements. there is no unnecessary duplication of effort within the Agencies/Services or the Department of Defense.

H. OTHER APPROPRIATION FUNDS: Not Applicable.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: Not Applicable.

J. MILESTONE SCHEDULE:

PLAN	MILESTONE
NOV 1989	Define Chip Architecture
MAY 1989	Pilot Lines in Place
FEB 1991	Fabricate Prototype Modules
MAY 1992	Initiate Advanced Technology and System Demonstrations
JUN 1992	Establish Advanced Prototype Modules
OCT 1993-OCT 1994	Demonstrate Modules

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603707E
PE Title: Prototyping of Advanced Technology and Innovative Concepts

Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
PP-01 Unmanned Undersea Vehicle	0	24,754	20,000	0	44,754
PP-05 Pilot's Associate	0	15,000	23,242	0	38,242
TOTAL OF PROGRAM ELEMENT*	0	81,054	64,242		

*Total includes classified projects not herein identified.

B. PROGRAM ELEMENT DESCRIPTION: Since the submission of the FY1990/FY1991 Biennial Budget Request, DARPA enlisted the assistance of former USDR&Es and DARPA Directors to clarify DARPA's role in prototyping. The recommendations of this ad hoc group were directed to the Secretary of Defense in a letter dated April 10, 1989. A restatement of the prototype initiative was communicated to the Secretary in a letter from David Packard and William Perry on April 3, 1989. In the latter communication, prototyping in Phase I and Phase II were defined. Both communications emphasized DARPA's primary role in Phase I prototyping. Phase I prototyping is for demonstration of system feasibility and military worth through a streamlined process. As such, those prototype efforts are closely aligned with DARPA's Experimental Evaluation of Major Innovative Technologies (EEMIT) Program Element. Consequently, the separate prototype Program Element is being phased out in FY1991 and previously designated projects are transferred to the EEMIT Program Element, 06030226E.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603707E
PE Title: Prototyping of Advanced Technology and Innovative Concepts

Project Number: PP-01
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
Unmanned Undersea Vehicle	0*	$24,754	$20,000	$68,586	$113,340

*FY 1989 was funded from Project EE-18, Advanced Undersea Technology (PE 0603226E)

B. BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES:

The objective of this program is to develop and demonstrate concepts for the operation of Unmanned Undersea Vehicles (UUV) in support of submarines.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:

- The UUV Program Office awarded the TAS Mission contract in December 1988. In addition, the Program Office will develop the specifications and award the contract by the end of the first quarter of FY90. FY 89 is very clearly a building year for the UUV Program. CSDL will continue efforts in vehicle fabrication and begin subsystem testing. The TAS Mission Contractor will begin development of the mission sensor systems and develop the critical interfaces that will join this system with the vehicle to produce a viable concept demonstration platform.

FY 1990 Planned Program:

- FY 1990 will be a key year for the UUV Program with the delivery of two vehicles by CSDL, the awarding of the contract, and the beginning of an extensive test phase for both vehicles and the TAS package. Further, FY 1990 marks the beginning of the transition of the UUV/TAS Program to the Navy for Full Scale Development (FSD) and, ultimately, production. By mid-FY90, specifications for the mission will be completed, and an RFP issued.

FY 1991 Planned Program:

- FY91 will witness the completion of the TAS demonstrations and the full assumption, by Navy, of the TAS/UUV FSD effort. Development will continue with operational demonstrations occuring in mid-FY92. The mission contract will award will be made early in FY91 and will mark the beginning of the final phase of the DARPA/Navy joint UUV program.

D. WORK PERFORMED BY: Major contractors are the Charles Stark Draper Laboratory, the Applied Physics Laboratory of the John Hopkins University and the Martin Marietta Corporation which is teamed with Lockheed, Hazeltine, and Raytheon. The MCM contractors are Lockheed Marine Systems teamed with Raytheon and AT&T.

E. COMPARISON WITH FY 1990 DESCRIPTIVE SUMMARY:

CSDL vehicle deliveries will commence at the 2nd QTR FY 1990 vice 4th QTR FY 1989 due to late start in awarding CSDL contract and late deliveries of pressure hulls. The MCM contract contract award was delayed from October 1989 to January 1990 while completing the competitive source selection process. Contract award for the ASW effort will be delayed from the end of FY 1990 to the beginning of FY91 to specification development.

F. PROGRAM DOCUMENTATION: Not Applicable

Program Element: #0603707E
PE Title: Prototyping of Advanced Technology and Innovative Concepts

Project Number: PP-01
Budget Activity: 2. Advanced Technology Development

G. RELATED ACTIVITIES: None

H. OTHER APPROPRIATION FUNDS: None

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. MILESTONE SCHEDULE:

Plan	Milestones
FY89	TAS Mission Conract Awarded
FY90	CSDL UUVs Complete
	TAS Mission Demonstrations Complete
	Navy Transition Begins
FY91	Mission Contract Awarded
FY92	Phase I Demonstrations Complete
FY93	Phase II Demonstrations Complete
	Mission Demonstrations Complete
	Program Completes

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603707E
PE Title: Prototyping of Advanced Technology and Innovative Concepts

Project Number: PP-05
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Title: Prototype of Pilot's Associate

Popular Name	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
Prototype of Pilot's Associate	7,743*	15,000	23,242	0	38,242

* In FY 1989 the Pilot's Associate Program was funded under Project ST-10 in PE #0602301E.

B. BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES: The avionics in modern single-seat combat aircraft have evolved from a small number of fully manual and relatively simple systems in WW II to today's complex and highly sophisticated collections of powerful sensors, processors, communications equipment, controls and displays. Through this evolution one fact has remained constant -- the pilot is in control. With increasing aircraft speeds and the need for the pilot to maintain the initiative in order to survive and accomplish his mission, the workload in the cockpit of the combat aircraft has increased to the point where pilot workload is a significant limiting factor in mission performance and survivability. One option to reduce the workload is to increase the level of automation. The other choice is to provide better quality information for the pilot and keep him in control. The Pilot's Associate program has completed a non-real-time demonstration of artificial intelligence techniques that aid the pilot without taking control away from him and promise to significantly improve mission performance and survivability. Project PP-05 takes the next step in making this technology available for both the next generation of aircraft and (through retrofit) current inventory aircraft by demonstrating, in a realistic ground-based simulation environment, real-time Pilot's Associate systems running on computers that are representative of the next generation of integrated avionics systems.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:

- Complete Demonstration 3, a demonstration via non-real-time simulation, of a level of functionality that is both useful for a near-term application, and achievable during a two-year prototyping phase with the objective of real-time performance on computers that are representative of next generation integrated avionics systems.

FY 1990 Planned Program:

- Design real-time prototypes of the Pilot's Associate systems.
- Investigate retrofit applications of Pilot's Associate technology to existing aircraft.
- Begin implementation for Demonstration 4, the first fully functional real-time demonstration of cooperating systems.

FY 1991 Planned Program:

- Complete Demonstration 4, the real time demonstrations of fully functional Pilot's Associate cooperating expert systems.
- Evaluate the ability of a Pilot's Associate to improve the mission performance and survivability of a single-seat fighter in simulated combat conditions and with realistic threats.
- Plan to be complete in FY 1991.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603707E
PE Title: Prototyping of Advanced Technology and Innovative Concepts

Project Number: PP-05
Budget Activity: 2. Advanced Technology Development

D. WORK PERFORMED BY: Lockheed Aeronautical Systems Company, Marietta, GA; Burbank, CA; McDonnell Aircraft Company, St. Louis MO; Wright Aeronautical Laboratories, Wright-Patterson Air Force Base, OH.

E. COMPARISON WITH FY 1990 DESCRIPTIVE SUMMARY: This project breaks out activity that was part of Project ST-10 in PE 0602301E. A $10M reduction in FY1990 and in the total program will reduce the scope of the technology transition activities planned for FY1990 and FY1991.

F. PROGRAM DOCUMENTATION: None

G. RELATED ACTIVITIES: None

H. OTHER APPROPRIATION FUNDS: None

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. MILESTONE SCHEDULE:

Plan	Milestones
Oct 1989	Demonstration 3 (Completion of Phase 1)
Sep 1991	Demonstration 4 (Completion of Phase 2)

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 0603739E
PE Title: Semiconductor Manufacturing Technology

Project Number: MT-01
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Title: Semiconductor Manufacturing Technology

Popular Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
SEMATECH	100,000	100,000	100,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This Program Element provides for a major Department of Defense (DoD) effort to develop advanced manufacturing methods for semiconductors used in weapon systems. This program will develop semiconductor manufacturing capabilities to correct deficiencies in the industrial base that have been identified by the Defense Science Board (DSB). The superiority of U.S. defense systems of all types is directly dependent upon superior electronics, a force multiplier that not only enhances the performance of weapons themselves, but also maximizes the efficiency of their applications through sophisticated intelligence and command and control systems. Electronics technology is, therefore, the foundation upon which much of our defense strategy and capabilities are built. The U.S. semiconductor devices and related industries that supply silicon materials or processing equipment are losing the commercial and technical leadership they have historically held in important aspects of process technology, manufacturing, and product design and innovation. If allowed to continue, this erosion of the U.S. semiconductor industrial base will result in the dependence upon foreign sources for electronic components which are critical for national defense. This program will stimulate the semiconductor manufacturing industrial base to develop advanced semiconductor materials, processing, equipments and manufacturing methods necessary to regain the superior technology needed for future weapon systems of all types.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:

- Selected remaining Centers of Excellence.
- Completed and equipped the Phase I facility.
- Installed the IBM/AT&T .8 micron baseline technology.
- Completed technology development and manufacturing demonstration of Phase I technology and transferred technology to member companies.
- Began Phase II technology development.

FY 1990 Planned Program:

- Complete technology development and manufacturing demonstration of Phase II .5 micron DRAM and SRAM production technology.
- Develop programs with materials and equipment vendors for the development of next generation of materials and equipment consistent with high-quality .5 micron production.
- Transfer Phase II technologies to member companies.
- Define facility requirements for the Phase III factory.
- Begin Phase III technology development.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 0603739E
PE Title: Semiconductor Manufacturing Technology

Project Number: MT-01
Budget Activity: 2. Advanced Technology Development

FY 1991 Planned Program:

- Construct and equip the Phase III factory.
- Begin Phase III technology development for .35 micron DRAM and SRAM unit processes.
- Develop programs with materials and equipment vendors for the development of next generation of materials and equipment consistent with high-quality .35 micron production.
- Demonstrate modular, flexible, automated Phase III technology and transfer it to member companies.
- Demonstrate self-sustaining technology and information infrastructure that will enable the continued development of first-quality materials, equipment, unit processes, factories, management systems for the manufacture of a world-competitive product that will provide the electronic baseline for military systems.

D. WORK PERFORMED BY: The major performer is the SEMATECH Corporation, Austin, Texas.

E. COMPARISON WITH FY 1990 DESCRIPTIVE SUMMARY: Not Applicable.

F. PROGRAM DOCUMENTATION: Not Applicable.

G. RELATED ACTIVITIES: Exploratory and Advanced Development of semiconductor components are being conducted under Army, Navy, Air Force, Defense Advanced Research Projects Agency (DARPA), Strategic Defense Initiative Office (SDIO) Program Elements. The estimated cost of all related activities is $50-75 million per year.

H. OTHER APPROPRIATION FUNDS: None.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: Not Applicable.

J. MILESTONE SCHEDULE:

Plan	Milestones
JUN 1990	Phases II technology development.
FEB 1991	Phases II manufacturing demonstrated.
JUL 1991	Equip Phase III facility.
MAR 1992	Phase III technology development.
AUG 1993	Phase III manufacturing demonstrated.
AUG 1994	Continuing Manufacturing Technology Infrastructure demonstrated.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603756E
PE Title: Consolidated DoD Software Initiative

Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Number & Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
CS-01 DoD Software Engineering Institute (SEI)	18,679	18,500	19,000	TBD	Continuing
CS-02 Software Technology for Adaptable Reliable Systems (STARS)	17,077	13,926	15,572	TBD	Continuing
Total	35,756	32,426	34,572		

B. BRIEF DESCRIPTION OF ELEMENT: The Consolidated Department of Defense (DoD) Software Initiative includes the DoD Software Engineering Institute (SEI) and the Software Technology for Adaptable, Reliable Systems (STARS) program. STARS will invent and demonstrate new technologies and model new acquisition practices needed to reduce the cost and increase the reliability of military software, particularly for systems requiring large amounts of software. The SEI will accelerate the transition of new computer software technology into use in military weapon systems.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603756E
PE Title: Consolidated DoD Software Initiative

Project Number: CS-01
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Title: DoD Software Engineering Institute (SEI)

Popular Name	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
SEI	18,679	18,500	19,000	TBD	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: This project supports the creation and operation of the SEI to accelerate transition of evolving software technology into the Services and industry for use in development of weapon systems. The SEI provides technical advice, consultation, and support to the military services and Defense agencies, as well as developing software engineering curriculum modules and facilitating their use in universities. The need for the SEI was documented in the reports of the Department of Defense (DoD) Joint Task Force for Software Technology for Adaptable, Reliable Systems, March 1983, and by the blue-ribbon Industry/Academia SEI Study Panel administered by the Institute for Defense Analysis for the Office of the Deputy Under Secretary of Defense (ODUSD) (R&AT), November 1983.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:

- Expanded the process assessment program for DoD and defense contractor organizations.
- Developed a testbed for investigating issues of software reusability and demonstrated use of reusable components.
- Expanded the Ada embedded systems testbed to real-time computing.
- Developed an Ada real-time kernel for distributed processors.
- Initiated development and delivery of a core program of courses leading to a masters degree in software engineering via video.
- Developed an economic model for adapting specific technologies.
- Established a rapid response capability to address DoD network penetration events.
- Acted as the coordination Center for DARPA's Computer Emergency Response Team (CERT) to improve the DoD computer and network security.

FY 1990 Planned Program:

- Expand the process assessment program with major defense contractors.
- Complete the F-14 and F-16 post deployment software support (PDSS) process models.
- Deliver the user interface prototyping system for C3I applications.
- Initiate cooperative evaluation of CASE tools for defense applications.
- Deliver runtime and support tools for distributed heterogeneous applications.
- Port and deliver the distributed Ada real-time kernel.
- Deliver core program of video courses.
- Expand the video based education program to DoD and industry.
- Continue workshops, conferences, seminars, and specialized direct support.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603756E
PE Title: Consolidated DoD Software Initiative

Project Number: CS-01
Budget Activity: 2. Advanced Technology Development

FY 1991 Planned Program:

- Deliver tool for managing software configuration.
- Develop and initiate defense industry use of software process measures.
- Develop improvement technique for DoD software program management.
- Develop systems technology assessment mechanisms.
- Initiate systems fault tolerance techniques.
- Deliver intelligent interactive requirements elicitation system.

PROGRAM TO COMPLETION: This is a continuing program.

D. WORK PERFORMED BY: Management and support will be performed by DARPA and the Military Services as appropriate. Major contractor is Carnegie-Mellon University, Pittsburgh, PA. The SEI is a federally-funded research and development center.

E. COMPARISON WITH FY 1990 DESCRIPTIVE SUMMARY: Not Applicable.

F. PROGRAM DOCUMENTATION: SEI Program Plan, SEI-87-CDRL-104/107 of 11 April 88.
The work performed under Program Element #0603756E is complementary to the work performed in the program elements below. There is no unnecessary duplication of effort within the Service/Agency or the Department of Defense. Related program elements are:

- Program Element # 0604740F, Computer Resource Management Technology
- Program Element # 0603728F, Advanced Computer Technology
- Program Element # 0603723A, Command and Control
- Program Element # 0603526N, Advanced Computer Technology
- Program Element # 0602746A, Tactical Automated Data Processing Technology

H. OTHER APPROPRIATION FUNDS: None.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. MILESTONE SCHEDULE:

Plan	Milestones
FEB 1990	Deliver intelligent video simulation system.
SEP 1990	Complete fourth FY 1990 self-assessment training course.
MAR 1990	Complete distributed, Ada real-time kernel.
SEP 1990	. .d real-time distributed systems to embedded testbed.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603756E
PE Title: Consolidated DoD Software Initiative

Project Number: CS-02
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Title: Software Technology for Adaptable, Reliable Systems (STARS)

Popular Name	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
STARS	17,077	13,926	15,572	TBD	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: Significant cost overruns, schedule slips and performance deficiencies in major defense programs are, with increasing frequency, blamed on software. Software problems are pervasive across the entire Department of Defense (DoD) and are particularly acute for very large systems. The DoD needs to find new ways to build reliable military software for much lower cost and on schedule. The goal of Software Technology for Adaptive, Reliablle Systems (STARS) is to learn how to increase the productivity of the software engineering work force by a factor of 10 and how to develop zero-defect software for critical components. The end-products of STARS will be: 1) A new reusable software technology together with supporting software engineering environments, repositories and tools; and, 2) Tested process and acquisition handbooks to put the new technology into practice. Because STARS will deliver a new technology for which there is no or little prior experience, the first years of the three five-year associate prime contracts awarded to Boeing, IBM and Unisys in August 1988 focus on numerous parallel thrusts to invent and demonstrate critical aspects of the new technology. Boeing is developing a new software engineering process for complex, real-time, embedded weapon systems; unifying description, design, development and documentation processes; pioneering new testing technology; and, demonstrating opportunities for economies in manufacturing automation. The IBM work emphasizes a new software-first systems development process for large systems, reusable software methods and repository technology. The Unisys work emphasizes large system configuration management; security, integrity and reliability technologies; and, domain tailorable environments to support a reuse technology. The primes will share and use the results of these several foundational thrusts in their individual end-product integration efforts.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:

- Published draft Software-First Systems Development Standard for systems in the Large -- a radical departure from standard practice.
- Published draft Handbook on acquisition changes required to use the software first process for military systems acquisition.
- Selected three military applications areas (e.g., B-1B Bomber, Air Traffic Control, Command/Control Afloat) for which to demonstrate STARS environments or repositories.
- Demonstrated the use of Ada as a common requirements and specification language driving trusted, adaptable code generation.
- Demonstrated a new strategy for significant software cost and schedule risk reduction.
- Developed integrity policies for enhanced software reliability through mandatory, computer controlled configuration management.

FY 1990 Planned Program:

- Sponsor interface bindings to Standards Group (e.g., ANSI, ISO, IEEE) to gain industry acceptance of new reusability technology.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603756E
PE Title: Consolidated DoD Software Initiative

Project Number: CS-02
Budget Activity: 2. Advanced Technology Development

- Deliver a capability to simulate software performance on over 60 different hardware architectures before defining designs.
- Develop ways to automate system construction using reusable software specifications, designs, code and documentation.
- Build domain specific applications libraries of reusable designs, code and documentation to show benefits of constructive technology.
- Deliver enhanced, taxonomic-based repository search and retrieval.

FY 1991 Planned Program:

- Deliver definitive adaptable software engineering environment and repository systems specifications for STARS final systems products.
- Demonstrate integrity and mandatory access controls essential to security and reliability of future military software.
- Integrate system life-cycle requirements, specifications, designs, code and documentation through engineering applications of DARPA sponsored research results transition to STARS in 1989.
- Apply knowledge-based, DARPA-developed technology to further enhance repository search and retrieval capabilities.
- Apply common specification and advanced internal representation forms to formal reliability and self-consistent life-cycle methods.

PROGRAM TO COMPLETION:

- Each prime deliver a software engineering environment adapted to a specific mission and built from common reusable parts.
- Deliver fully exercised software-first guides, procedures, handbooks and acquisition instructions.
- Deliver at least one repository system populated with multi-domain libraries of military software.
- Report productivity and capability achieved by applying STARS software development methods to operation military systems or subsystems.

D. WORK PERFORMED BY: Boeing Aerospace Corporation, Kent, WA; IBM Systems Integration Division, Gaithersburg, MD; UNISYS, McLean, VA and their subcontractors.

E. COMPARISON WITH FY 1990 DESCRIPTIVE SUMMARY: Prime contract awards slipped 5 months due to the size of the industry response.

F. PROGRAM DOCUMENTATION:

- STARS charter, 1 November 1984.
- STARS Technical Program Plan, 6 August 1986.
- STARS Program Management Plan, 6 August 1986.
- STARS Prime Contracts with Boeing, IBM and UNISYS, 4 August 1988.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603756E
PE Title: Consolidated DoD Software Initiative

Project Number: CS-02
Budget Activity: 2. Advanced Technology Development

G. RELATED ACTIVITIES:

- Related program elements:
- Program Element # 0604740F, Computer Resource Management Technology.
- Program Element # 0603728F, Advanced Computer Technology.
- Program Element # 0603723A, Command and Control.
- Program Element # 0602746A, Tactical Automated Data Processing Technology.
- Program Element # 0603526N, Advanced Computer Technology.
- The work performed under Program Element #0603756D is complementary to the work performed in the above program elements. There is no unnecessary duplication of effort within the Service/Agency or the Department of Defense.

H. OTHER APPROPRIATION FUNDS: None.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. MILESTONE SCHEDULE:

Plan	Milestones
MAR 1990	Deliver software prototype environments and repositories.
MAR 1991	Deliver system prototype environments and respositories.
MAR 1992	Deliver fully defined environment and repository systems (hardware and software) specifications.
MAR 1993	Deliver product quality environment and repository systems.
AUG 1993	Deliver final documentation and training data.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0605898E
PE Title: Management Headquarters

Project Number: MH-01
Budget Activity: 6. Defensewide Mission Support

A. RESOURCES: ($ in Thousands)

Project Number &Title	FY1989 Actual	FY1990 Estimate	FY1991 Estimate	Total Program
MH-01 Management Headquarters	16,043	16,506	17,778	Continuing

B. BRIEF DESCRIPTION OF ELEMENT: This program element provides funds 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 reproduction. 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 1989 Accomplishments: Funding under this program element in FY 1989 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. This project also includes funding to reimburse the various Service agents for costs associated with their administration of DARPA's contracts.

FY 1990 Planned Program: DARPA will continue the basic management and administrative support efforts for headquarters at approximately the same level as FY 1989. The major funding increases above the FY 1989 levels are due to new physical and information security improvements.

FY 1991 Planned Program: DARPA will continue the management and administrative support efforts for headquarters at approximately the same level as in FY 1990. In addition, funding is included for the planned relocation of DARPA's headquarters office.

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

E. RELATED ACTIVITIES: Not applicable.

F. OTHER APPROPRIATION FUNDS: None.

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0702807E
PE Title: IR Focal Plane Array

Project Number: IR-01
Budget Activity: 2. Advanced Technology Development

A. RESOURCES: ($ in Thousands)

Project Title: Infrared Focal Plane Array

Popular Title	FY 1989 Actual	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
IRFPA	8,640	19,010	20,676	Continuing	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The Infrared Focal Plane Array (IRFPA) Program establishes a manufacturing base for advanced infrared sensor arrays, which are a critical component for major weapon systems. Weapon system programs dependent upon the IRFPA include the Advanced Anti-Armor Weapon System-Medium (AAWS-M), the Lightweight Helicopter (LHX), the F-14D Infrared Search and Track (IRST) System, the Advanced Missile System-Heavy (AMS-H) and the Advanced Tactical Fighter (ATF). The focal plane array provides the search, target acquisition and tracking sensor for these systems. IRFPAs are currently produced with laboratory technology at low rates, resulting in low yields and high costs. The goal of this program is to produce IRFPAs meeting system requirements at approximately 1% of the current cost. The material selection is focused on mercury cadmium telluride (MCT) in the 8-10 micrometer spectral band, and platinum silicide (PtSi) in the 3-5 micrometer spectral band. Large area, uniform material wafers, automated wafer inspection, controlled processing modules, and high-throughput testing are major manufacturing initiatives addressed by this program. Integration of these advancements into a manufacturing line, producing IRFPAs in the configurations required for weapon systems, will provide affordable IRFPA sensor arrays in the quantities necessary to meet system needs.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1989 Accomplishments:
- Fabricated 480x4, 64x4 and 488x512 IRFPAs.
- Established specifications for IRFPA packaging and plan for system evaluation.
- Employed two (2) inch MCT gallium arsenide (Ga As) in IRFPA manufacturing.

FY 1990 Planned Program:
- Fabrication 64x64 IRFPAs on large area (3-inch) substrates.
- Demonstration of automated IRFPA testing with X10 increase in test throughput.
- Evaluation of 480x4 and 64x64 MCT IRFPAs, and 244x400 and 488x512 PtSi IRFPAs designed for target acquisition and missile seeker applications.
- Implementation of improved wafer morphology increasing die physical inspection yield by 40%.

FY 1991 Planned Program:
- Implementation of automated hybridization equipment increasing throughput X6.
- Demonstration of 960x4 scanning IRFPAs, 128x128 and 488x512 staring IRFPAs in system field tests.
- Material growth reactor on-line with throughput of three (3), three (3) inch substrates per day.
- Water level automated die inspection on-line with X100 reduction in test time.

Program Element: #0702807E
PE Title: IR Focal Plane Array

Project Number: IR-01
Budget Activity: 2. Advanced Technology Development

- IRFPAs manufactured in controlled production system with X100 cost reduction.
- IRFPAs integrated with low cost (less than $1,000) cryogenic packages.
- Field demonstration of IRFPAs meeting system requirements.

D. WORK PERFORMED BY: In-house work will be performed by: Army, Center for Night Vision and Electro-Optics; Navy, Office of Naval Technology; Air Force, Manufacturing Technology, MLTS. Potential contractors include: Aerojet (Azusa, CA), Amber (Goleta, CA), Ford (Newport Beach, CA), General Electric (Utica, NY), Honeywell (Lexington, MA), Hughes (Goleta, CA), NERC (Sudbury, MA), Rockwell (Anaheim, CA), Texas Instruments (Dallas TX), Hughes (Carlsbad, CA), Fairchild (Milpitas, CA). This is not intended to be a comprehensive list.

E. COMPARISON WITH FY 1990 DESCRIPTIVE SUMMARY: This program has been restructured based on the FY 1990/1991 Budget Submission.

F. PROGRAM DOCUMENTATION: None

G. RELATED ACTIVITIES: Development of IRFPA technology and devices is being undertaken under Department of Defense, Army, Navy, Air Force, Defense Advanced Research Projects Agency (DARPA), and the Strategic Defense Initiative Office (SDIO) program elements. The related program elements and titles are:

- Program Element 0602709A Night Vision Investigations.
- Program Element 0603774A Night Vision System Advanced Development.
- Program Element 0602334N Systems Support Technology.
- Program Element 0602204F Aerospace Avionics.
- Program Element 0602702F Command Control Communications.
- Program Element 0603737D Balanced Technology Initiative.
- Program Element 0603220C Surveillance, Acquisition, Track and Kill Assessment.

The work performed under this element complements the work in the above program elements. There is no duplication of effort with the Agencies/Services of the Department of Defense.

H. OTHER APPROPRIATION FUNDS: None.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: Not Applicable

J. MILESTONE SCHEDULE:

Plan	Milestones
Nov 89	Demonstrate 480x4 and 64x64 MCT and 488x512 PtSi IRFPA Manufacturing
May 90	Fabrication of arrays on large area substrates
May 91	Implement high throughput testing, large area wafer growth and automated wafer inspections.
Aug 91	Evaluate IRFPA modules in system field trials
Jun 92	Implementation of process module with in -situ controls
Jun 93	Demonstrate concept of integrated IRFPA manufacturing line
Aug 94	Demonstrate IRFPA manufacturing with X100 cost reduction

FY 1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0702807E
PE Title: IR Focal Plane Array

Project Number: IR-01
Budget Activity: 2. Advanced Technology Development

Aug 91	Evaluate IRFPA modules in system field trials
Jun 92	Implementation of process module with in -situ controls
Jun 93	Demonstrate concept of integrated IRFPA manufacturing line
Aug 94	Demonstrate IRFPA manufacturing with X100 cost reduction