(11)

VOLUME I

Supporting Data FY 1979
Budget Estimate

Submitted to Congress January 1978

Descriptive Summaries Of The

RESEARCH DEVELOPMENT TEST & EVALUATION
Army Appropriation FY 1979

DEPARTMENT OF THE ARMY DEPUTY CHIEF OF STAFF
FOR RESEARCH DEVELOPMENT AND ACQUISITION
RDTE PROGRAMS AND BUDGET DIVISION

UNCLASSIFIED

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RDTE Descriptive Summaries, FY 79

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Descriptive Summaries for program elements of the Research, Development, Test, and Evaluation, Army program, FY 1979, prepared to provide information for Congressional committees on each program element to be financed during FY 79 or FY 80.

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VOLUME I

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS

OF THE

RESEARCH, DEVELOPMENT, TEST, AND EVALUATION, ARMY PROGRAM

FY 1979

JANUARY 1978

Department of the Army
Deputy Chief of Staff for Research, Development, and Acquisition

FOREWORD

These volumes have been prepared to provide information on the US Army Research, Development, Test, and Evaluation Program for Congressional Committees during the Fiscal Year 1979 hearings. This information is in addition to the testimony given by US Army witnesses.

These volumes contain a descriptive summary for each program element to be financed during FY 1979. Descriptive Summaries for projects within the program elements to be financed during FY 1979 for $5.0 million or more appear on buff colored pages immediately following the applicable program element. Where there are several items under development within a project, a separate summary has been provided for each item that exceeds $5.0 million during FY 1979. A Test and Evaluation Section is provided for all major weapon systems.

There are twenty-nine major weapon systems descriptive summaries appearing in Volumes II and III. Major weapon systems are identified by an asterisk in the Table of Contents. The formats and contents of these volumes are in accordance with guidelines and requirements of the Congressional Committees insofar as possible. Information previously provided in the SAC Data Book is consolidated into these volumes. The SAC Data Book information appears at the beginning of each program element descriptive summary.

A direct comparison of FY 1977, FY 1978, FY 1979, and FY 1980 data in this Program Element Listing with data shown in the Program Element Listing dated January 1977 will reveal significant differences. Many of the differences are attributable to the following factors:

a. Restructuring of the FY 1977 and FY 1978 programs for comparability to the FY 1979 program structure.

b. Reclassification to provide greater visibility and contribute to the effective management of the RDTE program such as the following:

(1) RDTE Headquarters Management
(2) Joint Tactical Command and Control Communications
(3) Aircraft Electronic Warfare Self Protection Systems
(4) Further extension of the Single Program Element Funding Concept.

c. An FY 1978 net reduction of $9.555 million resulting from the manpower/spaces reduction imposed by Congress.

The funding information used in these volumes corresponds to that contained in the President's Budget. Procurement data is shown where applicable for items in engineering or operational development. Military construction data is shown where applicable.

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TACTICAL PROGRAMS (Continued)

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PROGRAMWIDE MANAGEMENT AND SUPPORT

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.11.01.A
DoD Mission Area: #110 - Defense Research

Title: In-House Laboratory Independent Research (ILIR)
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	14545	14722	16000	17500	Continuing	Not Applicable
A91	In-House Laboratory	14545	14722	16000	17500	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides Army RDTE activity directors the opportunity to perform highly promising and innovative research without having to acquire formal approval and subsequent funding. It is one of several measures used to strengthen scientific and engineering competence, improve morale, aid scientific and technical personnel recruitment and retention, and facilitate communication and interaction within the scientific community. Not only does this program provide the resources and interaction with the flexibility to respond quickly to new technical challenges, it also serves as a wellspring for innovative and imaginative ideas, of which the more promising ones progress into development programs. Approximately 500 research and development tasks were pursued in FY 1977.

C. BASIS FOR FY 1979 RDTE REQUEST: This request is based on the opinion that this program is important to Army laboratories and should be continued at the same level of emphasis. Funds are allocated directly to Directors of participating laboratories by the Assistant Secretary of the Army (Research, Development and Acquisition) and are not subject to reallocation by intervening echelons. This allocation is based on a review of the use of funds and of the accomplishments during the preceding fiscal year.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This program promotes creativity, innovation, efficiency, improved morale, and recruitment/retention of scientists and engineers by providing funds to maintain or increase individual professional competence through original work relevant to assigned military missions.

F. RELATED ACTIVITIES: The Navy and Air Force have similar programs. Coordination is accomplished through scientific symposia, literature reviews, exchange of research and technology resumes, and Department of Defense subject reviews.

G. WORK PERFORMED BY: In-House Laboratory Independent Research is performed in thirty-six Army RDTE activities.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: White Sands Missile Range conducted a study of the feasibility of designing a short focal length lens for an instrumentation camera utilizing a rotating prism for use in tracking high dynamic targets at short ranges. Testing of the lens demonstrated excellent performance. Its use may permit the collection of improved optical tracking data, and the theory for a new camera with two rotating prisms could ultimately lead to a new family of greater quality tracking cameras.

Night Vision Laboratory developed a new uncoded, nonscanning infrared imaging concept based on a unique thermo-optical detector process. A theoretical performance analysis indicates that this system might meet the Army's need for a compact, low power, low cost forward looking infrared system for man-portable and remotely piloted vehicle applications. Also a passive visible-to-infrared image transducer has been developed, which has successfully demonstrated simulation of dynamic far infrared imagery for the first time.

At Dugway Proving Ground research was undertaken to resolve confusion in the identification and the taxonomy of the members of the fungus family. Such identification is important in determining ecological patterns and possibly in control of the pathogenic species in their habitats. Dugway's efforts have demonstrated recognizable identifying characters and clarified identification of fifteen species.

The US Army Tropic Test Center has developed extensive standardized test procedures and facilities in the areas of jungle vision, jungle acoustics, and human performance in the tropics. Research was performed to collect objective performance data to support the evaluation of the suitability of equipment for use in the humid tropics. The jungle vision work also provided substantial input for a study of target presentation methodology for tactical field evaluation.

The Human Engineering Laboratory conducted research to design and build an ammunition transport kit which could be used to demonstrate and evaluate the concept of using "pod kits" as an efficient means of transferring "base round" ammunition from battalion ammunition transfer points to tanks operating on the forward edge of the battle area. Such a "pod kit" concept may minimize time of crew exposure during the process of resupply.

Combat Surveillance and Target Acquisition Laboratory performed an experimental study to determine the feasibility and limitations of optical parametric oscillators as efficient, tunable optical sources. To support classified optical countermeasure applications, work was concentrated on determining optimum design parameters for an auxiliary module to be used in lasers for rangefinders and designators. It was found that peak power conversion efficiency of nearly 80%, near the theoretical limit, could be achieved if pump laser beam divergence could be reduced to levels of about one milliradian.

Program Element: #6.11.01.A
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Army Engineer Topographic Laboratory conducted research to determine the potential of direct electronic Fourier transform devices for the extraction of terrain data from various types of imagery including remote sensor sources. In addition to the generation of terrain data and target signatures the technology has potential for real time on board acquisition of signatures of target features. The research has combined acousto-optics and electro optics in a unique manner to generate a photocurrent which contains the Fourier transform of the image.

At the Army Materials and Mechanics Research Center research carried out in a mass spectrometer has shown that there are volatile species formed when certain impurities such as chlorine are present along with hydrogen and nickel. This suggests that under the conditions in a gun chamber, where hydrogen appears to have a severe erosive effect, there may be an actual reaction of the hydrogen with the steel, with the volatile species formed contributing to the erosion of the gun tube.

At Natick Research and Development Command significant results have been achieved through the study of the stability of pressure-stabilized arches and their structural assemblies. In this effort a thorough assessment has been made of the structural capabilities of air-inflated structures, particularly pressurized and curved tubes. The design capabilities have been clarified and extended notably by preparing a computer code for such structures and for obtaining a minimum weight design. This research effort should lead to substantial improvement of Army inflatable shelters.

The Ballistic Research Laboratory demonstrated a technique of two-step multi-photo ionization using mass spectrometric detection of sodium atoms. The objective of this technique was to develop a tool for combustion diagnostics. The apparatus performed exceedingly well, with a signal to noise ratio in excess of 100,000.

At the Fire Control and Small Caliber Weapon Systems Laboratory an investigation was undertaken to reach the experimental velocity limit for the conventional propellant gun and to extend the available interior ballistic curves. A new conventional propellant high pressure chamber was designed and tested in combination with previously developed barrels. Using this laboratory launcher, velocities of 13,000 feet per second for a 31.5 gram payload and of 8,900 feet per second for a 210 gram payload at 175,000 pounds per square inch were achieved. These new data allow further extension of the available interior ballistic curves into the hyper-performance regions. This study has resulted in the design of a high velocity experimental tool and the acquisition of validated experimental performance data to extend the current interior ballistic data base.

The Tank-Automotive Research and Development Command studied high strength corrosion resistant metallic alloys. This effort investigated techniques for developing high strength, corrosion resistant metallic alloys which cannot be produced using conventional melting practices or powder metallurgy techniques. The program concentrated on the procedure of mechanical alloying which provided the mechanism for forming true alloys from metallic powders. After the alloy powders were mechanically formed, sintering was employed to prepare test specimens for subsequent metallographic and mechanical property evaluations. Techniques were employed to minimize diffusion effects prior to sintering to enable the evaluation of mechanical and corrosion resistance

properties related to mechanical alloying. Practical preparation of metallic alloys from melt was strongly dependent upon those characteristics which allow a liquid phase to be formed at a temperature near that of the constituent with the highest melting point, without adversely affecting those constituents with low melting and boiling points. The solid alloy formed from this melt has mechanical characteristics related to the equilibrium phase of the resulting composition and its micro-structure. The density of the metallic alloy formed by mechanical means was near that of the solid material. X-ray techniques verified that very fine dispersion can be achieved, with no elemental segregation in the mechanical alloy.

At the Institute of Dental Research an instrumental methodology was developed for improved, rapid, and precise identification of bacteria associated with combat wounds. A "fingerprinting" technique was devised involving the quantification of cellular fatty acids by high performance liquid chromatography. It was demonstrated that one can identify pathogenic organisms directly from body fluids by instrumental methods with speed and accuracy, which could eliminate lengthy and difficult culturing procedures, reduce laboratory man-hours, and reduce secondary infectious complications in the combat soldier thereby reducing patient care and combat manpower loss.

The Walter Reed Army Institute of Research studied the antigenic components of the cell wall of "neisseria meningitidis". The objective of this research program was to develop candidate vaccines to prevent meningococcal meningitis. Naturally acquired human bactericidal antibodies to group B meningococci were shown to be predominantly directed against labile determinants on the group B polysaccharide and the serotype protein. A new group B meningococcal vaccine which contains both of these important determinants in an anti-genically active state was produced and shown to be safe and immunogenic in animals. Approval for testing in human beings is pending. Serotype protein and lipopolysaccharide antigens on group A meningococci were identified, shown to be largely different than those on group B and C meningococci, and successfully used as a basis for epidemiologically significant subtyping of group A strains. A serogroup capsular polysaccharide has been produced as a vaccine for human use. It is safe and immunogenic in animals. Approval for testing in humans is pending. The epidemiology of meningococcal epidemics in recruits was intensively investigated to determine the immunological nature of susceptibility to the meningococci.

At the Army Research Institute, studies showed the importance of stereoscopic vision in training for nap-of-the-earth flight. A dynamic stereoscopic display system was developed and evaluated by using films taken through the windscreen of an OH-58 helicopter. The films demonstrated that pilots have stereoscopic cues available in their visual environment and that the low cost prototype equipment used to get this stimulus material is a viable alternative to complex, expensive systems. A computer-controlled display system was built and tested to allow stereoscopic presentations that vary in exposure, duration, luminance, focus, vertical and horizontal disparity, and contrast. An observer console with manual and vocal reaction type apparatus with a computer interface was also built by the experimenter.

At Harry Diamond Laboratory research was undertaken to investigate the feasibility of frequency multiplexing and multi-signal processing with acousto-optic techniques. Large bandwidth convolvers and correlators and a 125 to 250 megahertz correlator were utilized. Each signal was allowed a bandwidth of about 50 megahertz, allowing for a maximum of 10 signals to be multiplexed in the

case of the convolver, and of 5 signals for the correlator. A four-channel multiplex system has been designed, constructed, and operated in conjunction with the wide-bandwith "two-crystal" correlator. The correlator utilizes a bismuth germanium oxide (BGO) and a lithium noibate ($LiNbO_3$) delay line placed side-by-side. Because of the approximately 2:1 acoustic wave velocity ratio between $LiNbO_3$ and BGO, respectively, an acoustic signal inserted into the $LiNbO_3$ will pass an acoustic signal inserted earlier into the BGO. A laser beam impinging on the sides of the BGO and $LiNbO_3$ interacts via the acousto-optic Bragg interaction with both signals. If the $LiNbO_3$ signal completely passes the BGO signal within the given length of the lines, the laser light will contain the complete correlation between the two signals. In normal operation, the correlation is in the doubly-diffracted component of the laser light. The doubly-diffracted beam is then able to heterodyne against the undiffracted beam in a mixer diode, allowing extraction of the radio frequency (RF) information. The multi-signal processor has been successfully utilized to simultaneously process three different types of RF signals.

The Avionics Research and Development Activity research involved tapping the under-utilized sensing capabilities of the pilot, namely, the kinesthetic/tactical information channel. The Rotor Plane Control Device (RPCD) was designed according to the following guidelines: to display explicit kinesthetic/tactical command signals to the pilot for initiation of control stick motions; major modifications to present stick were to be avoided; frequency response of RPCD should be adequate for pilot applications; RPCD should be useable with regular flight gloves; and weight and power requirements should have no influence on control stick dynamics. The completed system was tested using the Tactical Avionics System Simulator (TASS) and results were excellent.

The Communications and Automatic Data Processing Laboratory formulated new methodology in systems modeling, simulation, and analysis utilizing nonstationary time series modeling techniques in order to aid communication system engineers in the design, analysis, and prediction of performance of higher order communication systems. Techniques and software were developed to model, analyze, and evaluate system performance through application of time-series analysis and modeling. Subsystems were considered, each influenced by a set of external variables of varying degrees. Analysis of time-dependent data collected on several communication systems was also considered. With regard to reliability, forecasting, and control; time series modeling was used to detect changes in system performance of the system process.

At the Electronics Technology and Devices Laboratory space-charge flow theory for equilibrium flow conditions was developed which predicts whether or not a given crossed-field amplifier (CFA) will have starting delay difficulties and whether or not a power dip will occur. In addition, the theory predicts efficiency and the fraction of total power intercepted by the circuit. Results of the theory have been programmed for the BURROUGHS B-5500 computer to provide a design and analysis tool for CFA development effort. Results of this work have impacted the Army PATRIOT air defense missile system effort by providing technical insight for the development of two high power CFA's for the PATRIOT transmitter.

The Waterways Experiment Station undertook an effort to verify data in the study of wave surge generation resulting from hurricanes, tsunamis, nearshore astronomical tide simulations, and some types of explosions and landslides. Curvilinear coordinate models have been developed with particular applications to the free and forced long-wave simulations for large (hundreds of miles) open coast stretches of the continental shelf. This project developed and verified a finite height, noncontinuous barrier coast boundary condition. These verification studies included five comparisons with hurricanes-of-record and six comparisons with data from physical models. The verified boundary condition has been incorporated, resulting in an advanced state-of-the-art curvilinear mathematical model. The model has the particular forte of requiring only nominal information about the shoreline or attached ponding area that can readily be obtained from crude topographic maps or aerial photographs.

At the Chemical Systems Laboratory research was undertaken to explore reactions of carbamate-oxime related to medical defense against chemical agents. Using stopped-flow spectrophotometry coupled with automated data acquisition and processing, the effect of a defensive agent on the eel acetylcholinesterase inhibition constants of carbaryl (a common carbamate insecticide) were investigated. It was found that the agent accelerates the inhibition. Most important, however, is that the cause of this accelerated inhibition is the result of the agent increasing the affinity of the enzyme for the carbamate. It thus appears that the agent is an "effector" of the enzyme, causing it to display altered kinetic properties. These results thus offer an explanation of published findings on the aggravation of carbaryl poisoning by the agent. Equally important, they provide an approach by which future researchers in the carbamate prophylaxis field can identify a counterproductive interaction without expensive animal testing.

2. FY 1978 Program: Based on the merits of the annual report submitted by each participating activity at the close of each fiscal year, new funding is allocated for the upcoming fiscal year. Directors of individual laboratories or comparable activities assign funds to both new and continuing promising work efforts. The freedom from a rigidly structured program and the resulting autonomy at activity level permit the Directors to effectively use their in-house laboratory independent research funds.

3. FY 1979 and 1980 Planned Program: This highly successful program will continue with no change in the basic objectives previously outlined. Changes in emphasis will occur as new ideas and techniques are considered and in accordance with advances in the state-of-the-art. The funding proposed for FY 1979 will continue this innovative program at about the same level of effort.

4. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.11.02.A
Title: Defense Research Sciences
DoD Mission Area: #110 - Defense Research
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	83942	88219	99700	116800	Continuing	Not Applicable
AF22	Research in Vehicular Mobility	450	410	430	500	Continuing	Not Applicable
AH42	Research in Materials and Mechanics	1925	2036	2100	2400	Continuing	Not Applicable
AH43	*Research in Ballistics	5516	5760	6486	7050	Continuing	Not Applicable
AH44	Research in Fluidics, Nuclear Effects and Ordnance Electronics	2290	1843	2290	2550	Continuing	Not Applicable
AH45	*Air Mobility Research	4485	4950	5210	5700	Continuing	Not Applicable
AH46	Research in Signal Detection and Low Energy Lasers	1165	1300	1400	2000	Continuing	Not Applicable
AH47	Electronic Devices Research	1760	1900	2000	2100	Continuing	Not Applicable
AH48	Electromagnetic Propagation and Antenna Research	685	900	1220	1350	Continuing	Not Applicable
AH49	Missile and High Energy Laser Research	1079	1300	1680	2000	Continuing	Not Applicable
AH51	Combat Support Research	665	750	800	900	Continuing	Not Applicable
AH52	Research in Support of Equipment for Individual Soldier	1684	1715	1780	2000	Continuing	Not Applicable
BH57	*Research in Scientific Problems with Military Applications	23677	26576	31500	40000	Continuing	Not Applicable
AH60	*Research in Large Caliber Armaments	4944	5000	5160	6000	Continuing	Not Applicable
AH61	Research in Small Caliber Armament	3240	700	800	1050	Continuing	Not Applicable

Program Element: #6.11.02.A
DoD Mission Area: #110 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
AH63	Research in Electronic Warfare	0	100	100	100	Continuing	Not Applicable
AH68	+Processes in Pollution Abatement Technology	0	0	200	245	Continuing	Not Applicable
BS01	*Basic Research on Military Injury and Diseases	7558	8373	10010	11226	Continuing	Not Applicable
BS02	Basic Mechaniems of Recovery from Injury	1306	1337	802	0	Not Applicable	Not Applicable
BS03	Medical Defense Against Biological Agents	2541	2702	3022	3290	Continuing	Not Applicable
BS04	Identification and Health Effects of Military Pollutants	350	385	420	487	Continuing	Not Applicable
BS05	Military Burn Research	1437	1510	1690	1888	Continuing	Not Applicable
BS06	Combat Dental Materials and Techniques	690	726	812	882	Continuing	Not Applicable
BS07	Helicopter, Combat Crew, and Airborne Medicine	326	343	380	574	Continuing	Not Applicable
BS08	Environmental Stress, Physical Fitness and Medical Factors in Military Performance	1127	1184	1925	2640	Continuing	Not Applicable
AT22	Research in Soil and Rock Mechanics	310	341	425	575	Continuing	Not Applicable
AT23	Basic Research in Military Construction	240	264	510	685	Continuing	Not Applicable
AT24	Research in Snow, Ice and Frozen Ground	1410	1557	1425	1650	Continuing	Not Applicable
A31B	Night Vision Devices Research	4490	4730	4900	5400	Continuing	Not Applicable
B52C	Research in Geodetic, Geographic and Mapping Sciences	1300	1518	1362	1658	Continuing	Not Applicable

Program Element: #6.11.02.A
DoD Mission Area: #110 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
B53A	Research in Atmospheric Sciences	2736	3500	3315	3500	Continuing	Not Applicable
A71A	Research in Defensive Systems for CW/BW	1442	1400	1900	2100	Continuing	Not Applicable
B74A	Research in Human Engineering	1008	1199	1290	1701	Continuing	Not Applicable
B74F	Basic Research in Behavioral and Social Sciences	2106	1910	2356	2599	Continuing	Not Applicable

* These projects are covered by separate descriptive summaries.
\+ This is a new project.

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Research performed under this program in the physical, biological-medical, engineering, environmental and behavioral-social sciences establishes and supports new Army capabilities and provides solutions to identified Army problems. Each project is associated with a particular Army laboratory or installation. Flexibility exists to respond to scientific and technological opportunities. This research program addresses requirements listed in the Army Science and Technology Objectives Guide.

C. BASIS FOR FY 1979 RDTE REQUEST: New and continuing research will provide the Army with improved and advanced weapons and with improved care and support of the individual soldier, and will be responsive to objectives defined by the Army user.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This program supports research to establish Army technical expertise in the physical, engineering, environmental, biological-medical, and behavioral-social sciences directly related to Army needs and to the solution of identified Army problems. It provides the base for subsequent exploratory and advanced developments in Army related technologies and for new or improved military capabilities in: armor; new materials for armaments; weapons and munitions; electronics; communications; seekers; detectors; surveillance and tracking systems; propulsion and aerodynamics for missiles; energy conservation; energy conversion; environmental quality; construction and field fortifications; medical and biological sciences; food; clothing; soldier support; night and foul weather operations; terrain characterization; vehicle mobility; navigation; and human-weapons integration. Research in the physical and engineering sciences is generally carried out in the laboratories of the US Army Materiel Development and Readiness Command and by contracts with industry, universities, and other Government agencies from these laboratories. Research on grants or contracts with the academic community, industry and not-for-profit organizations, is administered by the Army Research Office, an agency of the US Army Materiel Development and Readiness

Command. Research involving environmental sciences, military construction, and navigation is carried out in laboratories of the Corps of Engineers and at the Atmospheric Sciences Laboratory of the US Army Materiel Development and Readiness Command. Research in the medical-biological sciences is pursued in several laboratories under the US Army Medical Research and Development Command. Research in human behavior and human interaction with weapon systems is conducted at the Human Engineering Laboratory of the US Army Materiel Development and Readiness Command and at the US Army Research Institute for the Behavioral and Social Sciences.

F. RELATED ACTIVITIES: The Navy, Air Force, and other Department of Defense agencies, National Aeronautics and Space Administration, National Academy of Sciences/National Academy of Engineering/National Research Council, National Science Foundation, Department of Interior, Department of Energy, National Bureau of Standards, Department of Health, Education and Welfare, other Government agencies, Government agencies of allied nations and the industrial and academic community sponsor related research in some areas of this program. Coordination to eliminate duplication is accomplished by Tri-Service reviews; exchange of progress reports and technical reports; inter-Service/agency liaison; and formal, national and international meetings and symposia. Informal coordination occurs through: visits to Governmental, industrial and academic laboratories and installations, and review of the scientific literature. The Army's Defense Research Sciences program is included in the Tri-Service Technology Coordinating Papers. Additional details on related activities are provided in individual project descriptive summaries.

G. WORK PERFORMED BY: The research supported under this program is performed by in-house laboratories and activities; academic institutions, not-for-profit organizations and industrial laboratories through contracts and grants. Specific contractors are listed in the project and scientific area descriptive summaries. The laboratories/activities responsible for research under this program are the following, listed by major Army developing agencies:

US Army Material Development and Readiness Command:

Tank-Automotive Research and Development Command, Warren, Michigan
Materials and Mechanics Research Center, Watertown, Massachusetts
Ballistic Research Laboratory, Aberdeen Proving Ground, Maryland
Harry Diamond Laboratories, Adelphi, Maryland
Aviation Research and Technology Laboratories, Moffett Field, California
Combat Surveillance and Target Acquisition Laboratory, Fort Monmouth, New Jersey
Electronics Technology and Devices Laboratory, Fort Monmouth, New Jersey

US Army Corps of Engineers:

Waterways Experiment Station, Vicksburg, Mississippi
Construction Engineering Research Laboratory, Urbana, Illinois
Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire
Engineer Topographic Laboratories, Fort Belvoir, Virginia

US Army Medical Research and Development Command:

Walter Reed Army Institute of Research, Washington, DC
Letterman Army Institute of Research, Presidio of San Francisco, California
Medical Research Institute of Infectious Diseases, Fort Detrick, Maryland

US Army Materiel Development and Readiness Command (cont.)

Communications and Automatic Data Processing Laboratory, Fort Monmouth, New Jersey
Electronics Warfare Laboratory, Fort Monmouth, New Jersey
Missile Research and Development Command, Redstone Arsenal, Alabama
Mobility Equipment Research and Development Command, Fort Belvoir, Virginia
Natick Research and Development Command, Natick, Massachusetts
Large Caliber Weapon Systems Laboratory, Dover, New Jersey
Benet Weapons Laboratory, Watervliet, New York
Fire Control and Small Caliber Weapon Systems Laboratory, Dover, New Jersey
Army Research Office, Research Triangle Park, North Carolina
Night Vision and Electro-Optics Laboratories, Fort Belvoir, Virginia
Atmospheric Sciences Laboratory, White Sands Missile Range, New Mexico
Chemical Systems Laboratory, Aberdeen Proving Ground, Maryland
Human Engineering Laboratory, Aberdeen Proving Ground, Maryland

US Army Medical Research and Development Command (cont.)

Medical Bioengineering Research and Development Laboratory, Fort Detrick, Maryland
Institute of Surgical Research, Fort Sam Houston, Texas
Institute of Dental Research, Washington, DC
Aeromedical Research Laboratory, Fort Rucker, Alabama
Research Institute of Environmental Medicine, Natick, Massachusetts

Office of the Deputy Chief of Staff for Personnel:

US Army Research Institute for the Behavioral and Social Sciences, Arlington, Virginia

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Materials and mechanics research provided design and construction of reliable Army structures, new steels and other new alloys for weapon and armor applications, and predictive computer simulations to assess material behavior. New holographic vibrational analysis allowed sensitive detection of vibration and stress in tank/automotive parts. Improved neutron radiography was devised to detect structure defects and to measure propellant burning rates. New high temperature ceramics and composite windshields which resist high energy laser rays were developed. The erosive effects of gaseous products of combustion in gun tubes were assessed. A new 19 perforation gun propellant showed an increase in muzzle velocity without increased barrel erosion. Fluidics research resulted in 13 patent disclosures and two awards for amplifiers with greatly increased dynamic range. The new Utility Tactical Transport Aircraft System (formerly UTTAS, now BLACK HAWK) helicopter will have a recently developed fluidic flight stabilizer. Research in lasers has provided new millimeter wave length lasers with predicted and demonstrated potential for foul weather penetration and operation in dust and smoke, and new high quality pentaphosphate laser host crystals for low cost mini-laser applications in rangefinders and designators. A carbon monoxide infrared laser activated by nuclear reaction was demonstrated. New, inexpensive laser-specific reflectors were developed as countermeasures against threat lasers. In electronics research, the new pressure oxidation method developed by the

Army for producing hi-grade silicon oxide semiconductor materials is now being used by contractor manufacturers. Lithium, used in rechargeable batteries for electronics increased their amperage 5 to 10 fold. For night vision, selenium doped silicon detectors were designed, sensitive enough to be used without coolants. Communication problems in built-up battle areas (cities) have been assessed and are being addressed. Earlier materials and electronic devices research resulted in new semiconductors for integrated circuits, dielectric and electro-optical devices, electron beam devices for printed circuits and holographic methods that make possible superresolution of images on a television monitor. Lightweight electrical conductors of intercalated compounds have been demonstrated. Ultrasensitive explosives detection by an enzyme reaction has been improved. Improvements were also achieved in fuel cells using refractory metal catalysts. Food research yielded rapid methods for assaying microbes in cooked frozen vegetables and for quantifying the nutritional availability of iron in common foods. This program continued to provide many advances in food improvement, storage and wholesomeness. Natick Laboratory's research for conversion of cellulosic materials into glucose has received worldwide attention. Fundamental research in the biomedical sciences led to protection of the soldier from diseases and adverse environments worldwide, and enhanced his recovery following sickness or injury. New and classical methodology was developed to solve infectious disease problems of troops in military operations and to evolve procedures for treatment of psychiatric ineffectiveness and protection of military personnel against insect-borne diseases. Skin characteristics of personnel susceptible and resistant to skin diseases were determined and the nature of changes related to disease or injury identified. The role of lymphocytes and immunologic response in fungus infections were described improving the probability of eventual development of an antifungal vaccine. Bioassay techniques for evaluation of insect repellants were tested and improved. New basic knowledge of nutritional requirements during stress, exercise, and metabolic disease was obtained. A new blood substitute was developed as the result of fundamental studies of resuscitating solutions. Basic studies of the biochemical and physiologic changes that occur early in infection have aided the development of improved methods for rapid diagnosis and treatment of diseases that constitute biological weapon threats. Similarly, biochemical and immunologic studies led to improved vaccines needed to counteract the offensive biological warfare capability of potential enemy forces. New, ultrasensitive bioassay systems for detecting low concentrations of toxic substances were explored and new behavioral and hematological toxicity testing procedures were developed. Burn wound studies continued to elucidate the factors related to rapid healing, prevention of infection and recovery of muscle, nerve and tendon function. New dental materials for repair of injuries of the oral region which affect readiness and performance were developed. Products include materials which effect tooth repair and stability, tooth replacement and bridgework repair. Aeromedical research has led to identification of vibration, toxic gas, noise and visual hazards related to helicopter, armor and other vehicular operations. Improvements in protective seats, restraint systems, life support systems and personnel protective equipment systems resulted in better safety, comfort, communication and vision for crew members. Research in military environmental stress led to improved understanding of heat and cold effects on combat performance. Methods of determining susceptibility to high elevation hypoxia were developed. Studies were started to determine standards for soldier performance in, and the health and environmental effects of smoke. The engineering laboratories have devised: new methods of traffic damage assessment; new predictive techniques and computer codes for earth penetrating warheads into various geologic targets; and new computer models applicable to global procurement of military construction. They also have established restoration test sites to study methods for restoring damaged terrain, and have developed new theories for high speed imaging in geodetic mapping. A high speed parallel scanning system to extract terrain features from aerial photographs was developed.

Effects of the atmosphere, (wind, clouds, turbulence) upon propagation of laser beams were provided to Army, Navy, and Air Force users to predict behavior of their high energy lasers. Improved smoke models are now operable for more accurate assessment of obscuration and operability of US optics and guidance systems in smokes. Atmospheric models were also developed for meteorological systems required for smoke employment. Research in defensive systems for chemical and biological warfare has resulted in new improved capabilities for biological detection, identification and decontamination. Significant progress was made in rapid methods for remote detection and identification of air-borne clouds of microorganisms by lasers. Mathematical models of the behavior of gas mask protection materials, especially the absorbent fillers, were developed which predict behavior under several different atmospheric conditions. Anti-nerve agent poisoning treatment and prophylaxis have been developed. Medical defense against chemical agents was enhanced by the development of systems permitting studies of the spontaneous reaction of enzymes following nerve gas poisoning. Unique work in the behavioral and social sciences has resulted in findings on the effects of noise on man, central nervous system functioning, memory and learning ability, perception, and relation of the eye movement of helicopter pilots to their performance. Studies in correllation of effectiveness of leadership and unit performance were completed; race is not a factor. Studies of Army performance and training have produced good information on learning and teaching techniques, predictive models for military performance, and strategies and techniques for long range career planning and decision making. The safety of antitank weapons used in city fighting has been assessed. More accomplishments typical of this program element are presented in the following major project and scientific area descriptive summaries: AH43, Research in Ballistics; AH45, Air Mobility Research; BH57, Research in Scientific Problems with Military Applications; AH60, Research in Large Caliber Armaments; and BS01, Basic Research on Military Injury and Diseases.

2. FY 1978 Program: The Army's Defense Research Sciences program is a broad and continuing program that exploits new theoretical concepts, experimental data and results. Scientific areas of investigation are usually long term with termination or addition of areas occurring as science advances. The program is modified as appropriate to address new or changed Army requirements or problems. Details on larger projects in this program element are given in separate descriptive summaries. Research in vehicular mobility utilizes holographic techniques to analyse vibration and thermal stress in tank/automotive components, and reflection and transmission of light to furnish surface crack analysis. Studies of the dynamics of agile tracked vehicles in steady state and transient modes are being initiated. Other research topics in this area include: polymers for tank chains; laser designator susceptibility; shock-pressure and adaptive suspension modeling; and ammunition compartment design. Materials and mechanics research is concerned with the discovery and evalution of noise damping materials for: helicopter components; metal insulator transition materials for thermal switches; 3-dimensional modeling of tension failure in laminated composites; and modeling of projectile produced damage. Other materials research is devoted to prevention of gun barrel erosion, radar transmitting materials, high energy laser countermeasure materials and nondestructive testing. The design capabilities developed for fluidics are being used to develop new fluidic laminar proportional amplifiers. Fuzing, fuze materials and research in new fuze power supplies continue. A new Army research plan in near-millimeter waves has evolved which will support novel work in generation, propagation and detection of near-millimeter waves to penetrate fog, haze and smoke. Fundamental efforts continue in the areas of quantum electrodynamics, opto-electronics, and electrophysics/chemistry of lasers related to new/advanced system concepts for surveillance, target acquisition, terminal homing, fire control, communications, avionics, and

optical countermeasures. Present theoretical efforts should contribute to miniaturization, improved performance, reliability and efficiency of lasers in the mid-infrared, far infrared and submillimeter regions. Research on active reflector filters to counter enemy radiation will continue. A high contrast cathode ray tube with a minimum of 6 to 1 contrast in direct sunlight is nearing completion. Electro-luminescent films for displays are also studied. Improved silicon wafers for integrated circuits are anticipated from refined low temperature/high pressure oxidation techniques. Electron spin resonance, Auger sputtering profiles and electrical interface studies are being used to analyze charge defects on metal-oxide semiconductor structures. Other research in electronic devices includes electron beam lithography, reliability physics and failure mechanisms, semiconductors for microwave integrated circuits, millimeter wave materials and microwave tubes, ferrite phase shifters for radar, surface acoustic wave devices, and lithium electrolytic cells for power supplies. Antenna research includes studies of dielectric and microstrip millimeter wave antennas and bandwidth/size limitations of vehicular very high frequency antennas. Communications in built-up areas using ultraviolet transmission may be possible. This is being studied as a means to reach around signal path obstructions caused by atmospheric scatter. Missile related research involves determination of speckle effects in near-millimeter wave images and false alarm rates in experimental guidance and control systems. New methods for producing carborane propellants by laser induction are promising and are being pursued. Current work also involves: sled tests of rocket plume effects on missile aerodynamics; electro-optical guidance links; superradiant lasers; thermal homing versus reflective and luminescent target surfaces; guidance and control; and missile launch tube materials. Electronic warfare research provides means for increasing the efficiency of electro-optical intercept systems. Night vision research originates and exploits new concepts for sensing targets, and for image intensifiers for night surveillance and target acquisition. Areas of concentration are: smart sensor research and image processing; target signatures in limited visibility conditions; thermo-electric detection; enhanced imaging at 1 to 2 micron wavelengths; uncooled detectors; uncooled far infrared imaging concepts; and silicon charge coupled devices for second generation infrared imaging devices. Research in combat support provides a data base for mine detection, for hardening vehicles to mine blast, for understanding reactions in fuel cells, and for improving electrical conductivity of new conductors. These projects solve problems in mobility and service support. The individual soldier's needs are backed up by research in nutrition, food stability and sensory abilities. Other research is devoted to converting waste materials into useful products and optimizing dyes for clothing and camouflage. Small caliber weapons research includes optical effects of tracers, analysis of barrel motion, and mechanics of rifle barrel wear and erosion. Research in defensive mechanisms for chemical warfare and biological warfare obtains fundamental information in support of new biological and chemical defense materiel. Examples of this effort are toxicity studies, medical prophylaxis and therapy for chemical agents, poisoning, and methods to identify metabolic pathways for chemical agents. Smokes and smoke generation is a major consideration in this program. Data will be gathered to develop protective formulations for insect repellents and prevention of injury from prolonged water exposure, ultraviolet light and fungal infections. Antigens required to develop an effective antifungal vaccine will be prepared. Nutritional surveys will be continued and nutritional requirements during stress, disease and injury will be investigated. New procedures for increasing the storage life of human blood will be investigated. Fundamental studies of American, Asian and African hemorrhagic fevers will provide essential data for eventual development of vaccines against these potential biological weapon agents. The pharmacology, toxicity and efficacy of candidate drugs for aerosol treatment of respiratory diseases will be determined. Means of preventing stress ulcers and septic shock will be sought and the optimum blood viscosity and state of

hydration in burn patients will be determined. The use of electrostatic ceramic deposition and intra-oral laser welding of non-noble metals will be used to fabricate dental prosthetic devices. The feasibility of using gingival fluid as means of assessing health status and for diagnostic screening will be determined. Multi-cpter pilot psychomotor performance and the psychophysiology of vision and acoustics will be examined as they relate to operational flight and accidents. Studies of human adaptation to environmental extremes will continue. Experimental techniques for surgically shunting blood to facilitate physiologic cooling as a means of treating heat injury will be investigated. Determination of military physical performance requirements and a prospective health effect assessment of smoke and obscurant components will continue. Research in soil and rocks is conducted by the Corps of Engineers. Soil testing by nondestructive neutron analysis is being improved and applied this year. Work on effectiveness of earth penetrating weapons and development of guidelines for construction of reinforced earth structures is providing the basis for high strength emplacements. Laboratory tests of industrial waste continue to be of interest. A military construction process simulator addresses a range of iterative questions on a global scale to guide military construction. The fracture characteristics of structural composites are being identified. Cold regions research will develop portable analyzers for frozen soils. A report is being prepared on the Trans-Alaskan pipeline haul road which discusses the relationship of vegetation, soil, climate and thermal conditions, and the environmental impact of construction activities on the pipeline. A contract on environmentally induced failures in Army material is in progress. The technique of high speed parallel array sensing of aerial imagery, using new mathematical routines for pattern recognition and classification, is being used to support Tri-Service terrain analysis operations. Concepts for acousto-optical imaging and radar back-scatter analyses are being formulated. Atmospheric data are being compiled to aid in missile and rocket design. Water vapor absorption of wavelengths applicable to Army optical/imaging systems is being investigated in order to determine degradation and to improve tactical employment of these systems. In the behavioral and social sciences, the major efforts are: the development of training methodology and improved rater accuracy; the identification of leadership/subordinate factors in officer training; the development of trial computer learning systems; and the development of methodology to identify and support key organizational effectiveness factors. Human Engineering Laboratory conducts vision research related to Army problems in detection and acquisition of targets and validates impulse noise effects and methods to avoid hearing loss. Research relating to the female soldier to determine physical performance in combat support roles is being expanded.

3. FY 1979 Planned Program: New research efforts and continuation of FY 1978 programs relevant to anticipated Army needs and goals will provide basic information useful for advanced weapons and equipment, improved combat support, and better care of the individual soldier. The larger projects and one scientific area in this program element are described in separate descriptive summaries. Other proposed efforts are as follows. Research in vehicular mobility will determine dynamic response and mechanical properties to increase performance and survivability of vehicles in a hostile environment. Shock pressure resistance to internal explosion studies and laser susceptibility investigations will be conducted. New starts will include adaptive suspension research, modeling of wheeled vehicle agility, and human tolerance to ride. Important areas of research in materials will emphasize advanced materials for aircraft engines and noise damping in an aircraft structure. Armor and armor penetration will remain as important Army research thrusts. Interest will center on tungsten penetrators and a resumption of effort on superelastic

aluminum-bronze alloys. Methods will be found to harden helicopters (i.e., structural, skin, rotor, fuel tanks, canopy) against the potential threat of high energy laser weapons. Fundamental research for multimission applications will concentrate on polyurethanes, polyphosphazenes, epoxy-resins and metal insulator transition materials. In mechanics, major studies include inelastic behavior of weapon components, tension evaluation and damage zone mapping of components, crack growth, projectile produced damage, materials response under shock loading, and dynamic fracture and fragmentation. Fluidics research in components to replace electronic circuitry will continue in the areas of new, low threshold, high response linear proportional amplifiers and sensors, laminar digital amplifiers for low power logic devices with potential missile control applications, and speed control and compensation circuit modeling. New theories discovered in hole-electron pairs in dielectric materials such as silicon-silicon oxide structures will be examined to predict thickness dependence of hole transport and from this the optimum thickness of layers in this material. Near-millimeter waves to penetrate fog and smoke will continue to be a major Army area of emphasis. Detailed studies will be made of unstable waveguide resonators (lasers) and of the cyclotron resonance maser which may operate in the 300 gigahertz atmospheric window. Millimeter and near-millimeter wave solid state sources will be investigated with special emphasis on improving turn-on and reducing starting jitter. Effects of nuclear radiation upon electronic components and methods to harden that componentry will be investigated by geometric focusing of proton beams. The objective of heavy ion beam work will be to produce pulsed beams with energy of . million electron volts, 50 kiloamps of current and 100 nanoseconds duration. Laser technology will explore mini-lasers for fiber optic communications applications, near-millimeter wavelength lasers, new laser designs to improve beam quality and efficiency, new Q-switching materials for advanced two micron wavelength lasers, advanced design of a single element local oscillator with detector on a single material, and active filters for control of and protection against laser radiation. Integrated circuit processing by the pressure-oxidation method will be transferred to production programs. Electron-spin resonance measurements will be extended to study annealing at high temperature, metallic impurities, and ion implantation in silicon and silicon-silicon oxide semiconductors. Research in magnetic materials for microwave/millimeter wave devices will include materials for filters and isolators, microwave tubes and ferrite phase shifters. Materials to improve dielectric and electro-optic devices for communications applications, new lithium in organic cells and rechargeable lithium batteries to power electronics will also be major topics for research. Electromagnetic generation and propagation work will seek to reduce vulnerability of vehicular antennas, to advance the most promising small antenna concepts, and to study novel concepts for communications in urban battle. Delay-prediction for satellite navigation unpacks, and applications of digisonde to trans-ionospheric satellite signals will be studied under effects of strongly increased solar activity. We will continue studies to integrate microprocessors into vital communication system components; and study new modulation/demodulation, code/decode techniques for simplification of communication and higher channel capacity. Night vision device research will cover the areas of physiological optics and visual processing; intelligent target tracking techniques, especially in high clutter; and target cueing techniques with low false alarm rates. Atmospheric modeling and analysis of transmission of radiation to update the signatures of targets and to model actual battlefield obscuration and operability conditions will be developed. Image intensifiers for night viewing will be optimized. Molecular beam epitaxy should lead to improved photocathode efficiencies by a factor of 2 at 2 microns. Gallium aluminum arsenide charge coupled devices (CCD) will be selected to optimize uncooled low light level television and automatic target detection systems. A 100x100 element imaging array in the 1-2 micron spectral region may lead to a simple remote view imaging system. Far infrared technology will evolve from investigations of carrier lifetime, thermal match to silicon CCD chips and control of surface leakage in 8-12

micrometer detectors. New concepts for increasing higher temperature operation of extrinsic silicon detector materials will be analyzed. A laboratory thermo-optical imager concept will be evaluated and a laboratory solid state pyroelectric imager demonstrated. Quasihomogeneous radiation is only partially coherent (laser light is coherent) and will be used as a spoofer of lasers. Missile-related projected research will include: interferometric imaging of targets moving through an interference pattern; swept gain superradiance as a new laser effect; and photosensitized reactions to obtain new propellants. Submillimeter wave researchers will continue their propagation measurements and begin construction of a one meter aperture submillimeter radar imaging system. Other missile work will concentrate on aerodynamics, propulsion, simulation of guidance and control, and optimization of missile structures. A new project, entitled Processes in Pollution Abatement Technology, AH68, will begin in FY 1979 in order to obtain information which can be applied to pollution abatement for Army industrial activities at munition plants, depots and installations. Mine detection and mine neutralization research will be concerned with sensitive methods for detecting mines, and with the countermine problem of hardening vehicles to mine damage. Electrocatalysts and electrochemical activity which may increase efficiencies of fuel cells and new highly conducting graphites for use in electrical power generation and transmission will be explored. Nutritional standards, food analysis and composition, and interaction of microorganisms with food and with materials, such as cellulose, continue to be important areas of research for soldier support. Fire Control and Small Caliber Weapons Systems Laboratory will conduct studies on the emission of light from tracer bullets and continue to employ high speed neutron radiography to record behavior of plastic sabots in the bore. In the biomedical sciences, the cause of disease and of psychiatric casualties will be studied in order to establish preventive and therapeutic procedures. Improvements will be made in blood and fluids available for rapid resuscitation as well as improvements in methods for prevention or treatment of shock, infection, and post-burn respiratory complications. Fundamental biological, biochemical and immunologic studies of selected agents perceived to be candidates for use as biological weapons by enemy forces will lead to production of new vaccines. The hemorrhagic fever viruses will continue to be of primary interest. New toxicologic tests which are highly sensitive and relatively inexpensive for assessing environmental pollution will be developed. New application for biodegradable ceramics as hard tissue replacement following maxillofacial injury and the suitability of several dental prosthesis materials will be determined. Identification and assessment of the physiological effects of environmental hazards of combat and training in crew served weapon systems will be given major emphasis. Of special interest will be the bioacoustical effects of steady state impulse noise. Basic studies will include determination of risk criteria and exploration of normal and electronically enhanced human system capabilities consistent with operator efficiency and safety. Mathematical models of environmental stressors for field use will be improved. Basic mechanisms of the cellular and organic changes that occur in the body in harsh environments and their impact on combat performance and recovery from disease and injury will be investigated. Physical performance standards will be established to insure compatability between job assignment and individual physical abilities. Laboratory toxicity studies of smoke and obscurant components and detailed medical and specialized biological surveillance of personnel exposed to smokes and obscurants will be initiated. The decrease in project BS02 reflects reduced emphasis on nutritional and dermatological diseases. Atmospheric research will continue in small scale meteorological processes to aid artillery fire control, and in the design of remote sensor systems for prediction of degradation of laser beams by the atmosphere. Optical characterization of natural and battlefield aerosols in the 3 to 5 micrometer, 8 to 14 micrometer, and in the millimeter wavelength spectral regions will provide information to enhance land force operability in adverse weather, smoke and dust. Defensive systems for chemical and biological warfare will involve laser flourescence detection of biological aerosols in real time and work in support of defense against

chemical agent poisoning. The Army's smoke program will receive added emphasis to study phenomena which produce broad-band, strongly absorbing or scattering aerosols for screening against enemy electro-optical systems. In the engineering sciences, research will continue in exploration and interpretation of: geophysical properties; soil and rock mechanics; use of industrial waste materials for construction; computerized high speed track vehicle turning maneuver models; precast paving blocks; and of case histories and analytical methods for determining stress decay prior to failure of shales, clays and dense sands. Properties of cold region materials and investigations of cold ground will continue in order to develop methods to reduce difficulty of operations and aid in restoration of damaged areas. Research in geodetic mapping and geographic sciences will continue with emphasis on faster, more accurate and less costly methods for acquiring, processing, storing, and displaying maps and photographs. Research in behavioral sciences will focus on training and evaluating psychomotor skills. Two major efforts, one for predicting the future military manpower base and another for study of recruitment and retention factors, will be completed. Research will continue on training and validation of rater observer skill models and development of tools for adaptive instruction. Studies on hierarchial skill structures in military task performance will be concluded. Support for improvements in work methods and enhancing user/operator performance in military situations will continue. Human engineering research will determine the mental and physical capacities for specific tasks of male and female soldiers. Studies will continue in: battlefield sound classification and identification using subjects with some hearing loss; defining factors that cause hearing loss; predicting blast parameters in enclosures; and applications of voice activated switching in vehicles and communications systems. Learning and memory of military tasks, including long term performance with emphasis on female soldier performance, will be studied. Vision experiments will be conducted to determine the significance of peripheral vision when it is related to specific military operator tasks. Increased funding in FY 1979 over FY 1978 is intended to provide for maintaining a strong technology base taking into account increased costs of research equipment and personnel. Added funds will also support Army Areas of Emphasis in smokes and battlefield dusts; gun tube wear and erosion prevention; infrared target and background signatures; millimeter and near-millimeter waves for penetration of fog, dust and foul weather; fire control; and communications command and control. A new program entitled Defense Science and Engineering Program (DSEP) will be funded in FY 1979 to support high quality, problem oriented research at universities.

4. FY 1980 Planned Program: Adaptive suspension and interrelation between terrain sensors and vehicle ride performance, wheeled vehicle agility, and human tolerance to ride will be investigated. Materials research will concentrate on high temperature materials for aircraft engines, increased gun barrel life, missile guidance, nondestructive testing, inelastic behavior of structures, improved failure criteria, characterization of crack growth mechanics of damaged structures, and structural studies of complex polymers. Theoretical analysis and algorithms for design of fluidic components, new concepts for interfacing electrical and mechanical energy to fluidic energy, and new methods to transmit fluid signals will be developed for future design engineering. Supporting research in fuzing will include dielectrics, compact optical sources, and near-millimeter wave generation, including spectroscopy of gases used in near-millimeter wave generators. Research will continue on nuclear weapons simulation and hardening concepts for dielectrics and electronic components. New lasers and new laser concepts for targeting and communications applications, new laser materials, and a build-up of capabilities for optical material performance prediction will be major areas. It is expected that the emphasis on submillimeter and millimeter waves will result in the ability to see and target in smoke, fog and bad weather. Advanced materials and concepts for electronic devices will be achieved through low

temperature processing of silicon wafers, charge defect analysis of semiconductor basis materials, resist systems for electron beam lithography, better diagnostics for defect detection, and new galluim-arsenide-indium-phosphide semiconductors. Theoretical and experimental work will be continued for improved Army communications. It is expected that work will be completed in coherent imaging and high resolution radar in the submillimeter range. Decisions will be made on the usefullness of swept gain superradiant laser pulse generators in missiles, and on the use of laser induction to produce missile propellants. Activities on high energy lasers will depend upon FY 1979 results but new laser concepts will continue to be investigated and assessed for military applications. Night vision research related to visual image processing, battlefield surveillance, target signatures in clear and inclement weather, and in smokes will be conducted with emphasis on highly sensitive componentry and arrayed receivers. Meteorologic and atmospharic phenomena with special emphasis on measurements during the FY 1979 solar eclipse will be analyzed and results used to validate and improve weapon effects and communication models. Electronic warfare concepts in simulation with quasihomogeneous light sources will be extended. Power supplies and countermine research will continue including optimization of fuel cells and power conductors, and methods of mine detection. Food analysis, standardization and deterioration, food acceptance, and diet and menu optimization will continue to be important subjects for research. Small caliber armament research will concentrate on fire control concepts for the Army. Research on military diseases will emphasize vaccines against diseases characterized by high morbidity. Medical defense against biological weapons will emphasize biologic principles leading to new and improved vaccines, rapid and accurate diagnostic procedures, and more effective means of treatment. New toxicological tests for pollutants will be evaluated. Fundamental research on management of combat casualties will emphasize rapid resuscitation, wound and burn protection, and attenuation of shock effects. Dental research will include exploration of full application of neutron radiography and further development of photographic data transmission capabilities that will lead to more rapid diagnosis and surgical repair of combat wounds. Studies in psychophysiology of vision and sound will lead to improved crew performance and safety. Enhanced adaptibility and survival by the soldier in environmental extremes with improved performance will result from continuing studies on environmental stress. Psychological effects of hot and cold environments will be determined. The mechanisms of injury will continue to be of primary interest. The methodology for determining the chemical characteristics and toxicity of smoke and obscurant components will continue to be improved. Efforts in remote detection of microbial attack and nullifying incapacitating effects of chemical attack will continue both in-house and by contract. New smokes will be investigated for their infrared screening capabilities, optical and emissive effects and to understand particle size and dissemination phenomena. Approaches to screening against microwave and millimeter wave threats will be exploited. Basic relationships between the geological sciences and engineering will be established in the area of soil and rock mechanics. Research in military construction management to guide long-term construction planning and research leading to knowledge for the reduction of energy engineering costs will be continued. Properties of cold region soils, snows and ice, and factors to predict future environmental trends to enhance our operability in cold regions will be explored. Scientific areas of research in geodesy and mapping sciences will include: highly precise determination of contours and grading, automated techniques for pattern recognition, completion of aerial photo analysis of selected foreign terrain, and analysis of multiple scattering of electromagnetic signals from topographic surfaces. In FY 1980 the Army Research Institute will concentrate on development of criteria for evaluating training program effectiveness, development of a basis for predicting or controlling more efficient use of manpower resources, attempts to identify performance oriented training concepts, and development of a methodology for improvement of unit performance. The Human Engineering Laboratory's projected work will be in the areas of acoustics and audition to predict

and define effects of noise-induced hearing loss and establish safety criteria. Research will continue to examine how an individual's perception of control of a situation will enhance human performance. Efforts will continue to stress the significance of peripheral vision when it is related to specific military operator tasks. The planned programs for FY 1980 in the larger projects in this program element are described in separate descriptive summaries.

5. Program to Completion: This is a continuing program.

Project: #AH43 Title: Research in Ballistics
Program Element: #6.11.02.A Title: Defense Research Sciences
DoD Mission Area: #110 - Defense Research Budget Activity: #1 - Technology Base

A. DETAILED BACKGROUND AND DESCRIPTION: The objective of this research program is to advance the scientific areas of propulsion dynamics, launch and flight dynamics, warhead dynamics and mechanics, blast and kinetic energy projectile mechanisms and effects, ballistic protection, mathematical analyses, systems statistics, and decision theory. Major areas of emphasis in this program are devoted to the understanding of the processes involved in the operation of a weapon system such as the mechanics involved in gun barrel wear and erosion; the chemical kinetics under conditions of high temperatures and pressures in explosives and propellants; fluid dynamics and heat transfer involved in combustion, detonation, and incendiary processes; aerodynamics of projectiles, rockets, and missiles; and continuum mechanics controlling the interaction between explosives and metal. This research is a continuing integrated effort to provide the fundamental scientific and engineering base necessary to advance the myriad of weapon technologies. This effort is relevant to the entire spectrum of weapon systems ranging from small arms to large projectiles, missiles, and warheads.

B. RELATED ACTIVITIES: This research is related to efforts performed by the Navy, Air Force and the National Aeronautics and Space Administration. Coordination is accomplished by program reviews, exchange of program data sheets, research and technology resumes, technical reports, and liaison and attendance at scientific meetings and conferences. At Department of Defense level, coordination is achieved through program reviews sponsored annually by the Office of the Under Secretary of Defense for Research and Engineering. Broader multinational coordination is achieved through joint participation of Australia, Canada, United Kingdom and the United States in The Technical Cooperation Program, and participation in the North Atlantic Treaty Organization Advisory Group on Aerospace Research and Development. Data exchange agreements exist on various aspects of ballistics research with the Federal Republic of Germany, France, and the United Kingdom. This project is planned and executed in close coordination with all laboratories in the Army Armament Research and Development Command, which includes the following research projects and titles: AH60, Research in Large Caliber Armaments; AH61, Research in Small Caliber Armament; and A71A, Research in Defensive Systems for Chemical Warfare/Biological Warfare. The project is also closely coordinated with AH80, Ballistics Technology and with elements of the Army Research Office Project BH57, Research in Scientific Problems with Military Applications.

C. WORK PERFORMED BY: This project is performed or managed by the Ballistic Research Laboratory, Aberdeen Proving Ground, MD. The in-house effort is augmented through contracts with universities, industry, and other government agencies. Principal contracts are planned for Scientific Research Associates, Glastonberry, CT; Dyna-East, Wayneswood, PA; Stanford Research Institute, Menlo Park, CA; Calspan Corporation, Buffalo, NY; and Consolidated Development Corporation, Saltville, VA. Four additional contracts are anticipated approximating $100,000. Direct support to Research in Ballistics is also rendered through the Army Research Office under Project BH57, Research in Scientific Problems with Military Applications.

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

Project: #A143 Title: Research in Ballistics
Program Element: #6.11.02.A Title: Defense Research Sciences
DoD Mission Area: #110 - Defense Research Budget Activity: #1 - Technology Base

1. FY 1977 and Prior Accomplishments: Techniques and equipment have been developed which allow photographic observation of the burning surface of liquid monopropellants. Gun tube erosion was studied by the use of nitrogen implantation. The heat transfer code was modified, validated, and used to analyze gun tube erosion problems. Burning rate data was obtained for conventional single, double, and triple as well as nitramine base propellants. The high pressure interface conditions between lightweight sabots and high density penetrators were needed. New method was developed for calculating stress near a discontinuity in loading. The sabot discard and subsequent aerodynamics interaction with the projectile were modeled. Codes for computation of Magnus Effect on supersonic projectiles were modified to render good accuracy. Study to measure the actual flight forces acting on full scale projectiles show hope of identifying devices that can survive high-g launch and yield adequate data. Successful calculations were made of frequencies of a liquid during spin-up. Jet strengths of shaped charges were estimated using one dimensional stability model. Vulnerability study showed that both vulnerability reduction and logistical simplification are possible through fuel change. Fire extinguishing agents were shown to suppress the vapor phase of a propellant fire. Innovative armor concepts were investigated for the defeat of kinetic energy penetrators using sub-caliber techniques. Continuing progress was made on flow reactor system for neutral species detection and assembly of codes to study gas-phase chemistry of neutral species. A gas-dynamic model of muzzel flow was verified for predicting blast interaction with emerging projectiles. The effect of asymmetric muzzle device on dispersion was measured.

2. FY 1978 Program: Search for solutions to the basic pacing problems in the various technical areas of the project continue. For consolidated propellant charges, relationships between methods of preparation, physical properties and combustion characteristics are being developed. Burning rate data are being obtained for standard and newly developed propellants at pressures up to 1000 megapascals. For liquid propellants, burning rates, are being measured, energy release characteristics and flame products are being identified, thermochemical properties are being determined, and the hazards are being assessed. Hydroxlammonium nitrate base monopropellants are the primary propellant tested. In physical and chemical mechanisms of in-bore interactions, emphasis is on wear and erosion of gun tubes, in-bore dynamics, and mechanical behavior of solids. Tests in the shock tube gun are designed to allow parametric isolation of the effects of gas pressure, temperature, and gas flow, and the effects of gas flow on heating and erosion in the region of pure melting of steel. The wear reducing mechanism of additives is being deduced. In investigations of launch and flight dynamics, gun launch signatures are being measured and classified. Detailed boundary layer profile data are being used to determine the degradation of accuracy in computing the magnus effects on shapes with boattailed after-body. In warhead mechanics a major objective is to develop a good understanding of the mechanisms involved in the initiation of detonations and violent reactions in explosive charges subjected to various stimuli, and to define thresholds for ignition and initiation of high explosives subjected to fragment impact and crushing. Shaped charge research is predicting the temperature of jet formation and examining unsteady jet flow and jet breakup problems. Terminal effects and armor dynamics research is calculating pressure-time surface histories. 3-dimensional models of kinetic energy penetrators are being developed to determine the quantitative deformation mechanisms. Strain tests are being performed to assist in optimum designs of armor and penetrators.

Project: #AH43 Title: Research in Ballistics
Program Element: #6.11.02.A Title: Defense Research Sciences
DoD Mission Area: #110 - Defense Research Budget Activity: #1 - Technology Base

3. FY 1979 Planned Program: The FY 1979 program will: determine the dominant mode of erosion in hypervelocity guns; develop an interior ballistic code for consolidated charges; provide analysis of plastic sabot applications for 30-40 millimeter projectiles in hypervelocity systems; expand the interior ballistics mathematical model for liquid propellants and evaluate candidate propellants; upgrade models of ignition and combustion of propellants; obtain better understanding of stability problems in high length-to-diameter-ratio hollow projectiles being considered for training rounds; provide Magnus computational model for projectiles with slender boattails; complete the model of fragmentation process and parametric evaluation of the efficacy of controlled and preformed fragmentation techniques; complete stability analysis of shaped charge jets; complete quasi-one dimensional model for jet formation from rotating shaped charge liners; model the best composite penetrator configuration and materials to defeat spaced armor; select the best combination of fiber and matrix materials for complex armors and specify optimum anisotropic configuration for defeat of general classes of penetrators; evaluate elastoplastic constitutive relations through use in predictive codes and comparison with experimental data; exploit multiphoton ionization mass spectrometry and optoacoustic effects for flame diagnostics; characterize the electronic structure of nitro-compounds and its influence on the controlling processes of solid propellant burning; and apply monoenergetic X-rays to the high-speed in-bore analysis of propellant gases. The increase in funding is provided to render priority emphasis on the critical problems of gun tube wear and erosion and armor penetration. Research in Ballistics involves 65 professional researchers and 59 support personnel.

4. FY 1980 Planned Program: The FY 1980 program will continue progress in delineating the effects of recoil impulse, rate of fire, and weapon configuration on the effects of temperature distribution and heat transfer in gun tubes; the dynamic behavior of the projectile during the engraving process and through the bore; and effect of interior ballistic variations caused by ignition, combustion, or gas-dynamics phenomena at high pressures and high temperatures. Research in modeling and experimental verification of the launch environment of projectiles and weapons systems; the characterization of the flight environment of multi-range, special purpose ammunition; and improvement of kinetic energy penetrator materials and models of kinetic energy penetrator-target interaction will continue.

5. Program to Completion: This is a continuing program.

6. Major Milestones: Not applicable.

7. Resources ($ in thousands):

	FY 1977	FY 1978	FY 1979	FY 1980	Additional to Completion	Total Estimated Cost
RDTE,A Funds	5516	5760	6486	7050	Continuing	Not Applicable

Project: #AH45 Title: Air Mobility Research
Program Element: #6.11.02.A Title: Defense Research Sciences
DoD Mission Area: #110 - Defense Research Budget Activity: #1 - Technology Base

A. DETAILED BACKGROUND AND DESCRIPTION: This project supports research to advance the state-of-the-art in rotary-wing aerodynamics, structures, propulsion, and mathematical models. The objective is to expand the technologies in those areas which are most likely to produce improvements in operational effectiveness, safety, survivability and life cycle costs of Army aircraft. Aerodynamics research is oriented toward advanced airfoils and rotors and will address basic fluid mechanics, acoustics, dynamics, control and flight simulation. Structures research is oriented toward advanced materials and structural concepts such as advanced metal and composite aircraft components. Fatigue and fracture characteristics of these materials will be investigated and fracture control procedures and techniques will be developed. Propulsion research will be directed at small engine technology to improve the internal aerodynamics of combinations of compressors, combustors, and turbines, and to increase turbine operating temperatures. Mathematical modeling research will develop mathematical techniques applicable to problems associated with air mobility research.

B. RELATED ACTIVITIES: This project supports the Army's aeronautical research program conducted in joint participation with the National Aeronautics and Space Administration (NASA) in accordance with the agreement between NASA and the Army. Related research is performed by the Navy, Air Force, Department of Transportation, and Department of Energy. Coordination to eliminate undesirable duplication within the Department of Defense is accomplished by program and topical reviews; through the exchange of program data sheets, research and technology resumes, and technical reports; and by inter-service liaison and visits. Broader coordination, including international coordination and cooperation, is accomplished by participation in the Quadripartite Standardization Program, The Technical Cooperation Program, NASA Research and Technology Committees, and the North Atlantic Treaty Organization Advisory Group on Aerospace Research and Development. The program supported under this project is closely related to, and planned in conjunction with, the scientific program of contracts and grants with industry and academic institutions that is implemented by the Army Research Office under project BH57, Research in Scientific Problems with Military Applications, and the technology program supported under element 6.22.09.A, Aeronautical Technology.

C. WORK PERFORMED BY: This work is performed by the Research and Technology Laboratories of the US Army Aviation Research and Development Command. The laboratories involved are located at Moffett Field, CA; Cleveland, OH; and Langley, VA. Much of this work is performed jointly with NASA Research Centers at these locations. The top 5 known contractors for FY 1979 are ADVEX, Newport News, VA; Boeing Vertol, Philadelphia, PA; Creare, Inc., Hanover, NJ; Pratt and Whitney, East Hartford, CT; and United Technology Research Center, East Hartford, CT. The remaining contract program involves nineteen contractors for a total of approximately $1,050.000.

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Two dimensional tests of rotor airfoils at full-scale operating conditions have been completed on four airfoils of varying thickness. Analytically, the aerodynamic operating conditions for airfoils as a function of span and mission segment have been defined for rigid blades. The source of the large vibratory loads on the retreating blade has been traced to dynamic stall, while the factors influencing dynamic stall have been traced to the blade upper surface turbulent

boundary layer rather than the leading-edge-bubble bursting as originally hypothesized. Transonic numerical codes have been developed to provide two-dimensional unsteady lifting blade load calculations and have been extended to include three-dimensional non-lifting transonic calculations. These codes have been checked with experimental data. The laser velocimeter has been demonstrated in the wind tunnel and the pitch rig was demonstrated in the Transonic Dynamics Tunnel. Program Rotor-Body (PRB), and Flap-Lag Air Resonance (FLAIR) have been developed for understanding rotor instabilities, preliminary design, and detailed analysis of rotor blade stability characteristics. The in-flight acoustic measurement technique was utilized for the Source Selection Evaluation Boards on both the Utility Tactical Transport Aircraft System (formerly UTTAS, now BLACK HAWK) and Advanced Attack Helicopter (AAH). The data have improved the ability to analytically model rotor aerodynamic noise. A mathematical solution has been obtained which describes the details of the three-dimensional airflow through an 8:1 pressure-ratio, centrifugal-compressor impeller at one operating point, including the effects of viscosity. The presence of feedback or functional loops in the design of mechanical or electrical equipment can often make trouble shooting and diagnosis of malfunctioning hardware a challenging, if not impossible, task without replacing the entire piece of equipment. A theorem established during FY 1976 concerning optimal fault detection technique for loop-free systems has been extended to cover physical systems containing functional loops.

2. FY 1978 Program: Two-dimensional tests are being conducted on redesigned inboard airfoil sections for utility type helicopter rotors. Six advanced airfoil sections are being tested in the 7 x 10 feet wind tunnel to obtain dynamic stall data. The wind tunnel is being used to investigate active means of controlling or modifying dynamic stall. The demonstrated oscillating pitch rig capability for sinusoidal as well as random oscillations of full-scale blade sections is being used to test a production finished helicopter rotor blade section. Existing three-dimensional non-lifting unsteady small disturbance transonic potential models are being extended to provide calculations for lifting rotors. The angle-of-attack sensor system fabrication is being completed and flight tested on the observation helicopter (OH-58). Laser velocimeter in the 7 x 10 feet wind tunnel is being used to measure trailed rotor tip vorticity for several rotor tip planforms. Tests in support of the hub/pylon drag reduction program are being conducted. Theoretical efforts to define noise generated by blade-vortex interactions are being initiated. Tests on various rotor systems to obtain performance and noise data for hovering rotors are being conducted. The combined theoretical and experimental study of the airflow in high pressure-ratio, centrifugal compressors is continuing. Detailed measurements of this airflow are being made using laser velocimetry. This data will be used to validate and refine the mathematical solution previously developed. The Army work on special coatings for high-temperature ceramic materials to improve impact strength (toughness) is being continued under National Aeronautics and Space Administration (NASA) sponsorship as part of a joint Army/NASA program. Army research in ceramics is an attempt to develop a pressureless sintering technique for obtaining dense high-temperature ceramic materials in complex shapes with usable structural properties. Combustor research includes: initial variable geometry combustor testing on a single burner unit rig including flame stability and noxious oxide emissions testing and testing of premixed, prevaporized fuel systems designed to reduce pollutant emissions. Recent efforts have developed two computer codes; a two-dimensional lifting unsteady flow code and a three-dimensional non-lifting unsteady flow code. The latter computation has produced uniformly excellent comparison with experimental rotor data. To account properly for the rotor blade flow field, this work is being extended to include the full three-dimensional unsteady lifting computations.

3. FY 1979 Planned Program: A rotor blade section optimized with respect to unsteady flow conditions will be designed. Validation of unsteady two-dimensional airfoil data by means of model rotor tests will be initiated. Tests will be conducted on the pitch rig to provide new information on shock/stall interrelationships. Rotor blade tip planforms which show decreases in the maximum velocity of the trailed vorticity will be selected for wind tunnel testing. Trailed vorticity trajectories will be determined. The hub/pylon drag reduction investigation will continue. Structural optimization techniques to reduce blade loads and vibrations will be investigated. A concentrated effort will be initiated to mathematically model blade-vortex interaction noise. Data from hovering tests of model rotors with different geometric configurations will be analyzed and published. Optimization of the pressureless sintering process for high-temperature ceramics will continue. Initial attempts will be made to form complex shapes such as turbine blades and nozzle vanes. An ongoing program of research on abradable gas path seals will demonstrate the ability of such a seal to withstand 1000 thermal shock cycles at 2400°F material temperature. As part of this effort, an advanced theory of material wear will be completed. Efficient, long-life, high-temperature gas path seals are a vital necessity for the development of advanced, high-temperature gas turbine engines in the smaller sizes of interest to the Army. The development of technology for hybrid composite structures will continue. The increased funding will continue approximately the same emphasis on air mobility research. This project will support 153 in-house personnel.

4. FY 1980 Planned Program: Emphasis will be on establishing and validating realistic design criteria, establishment and acceptance of standardized two-dimensional test techniques, and two-dimensional tests of candidate airfoils through analytical design of airfoil families for specific rotor missions, two-dimensional tests of resulting airfoils, and oscillating tests and scale model rotor tests of promising airfoil candidates. Efforts will continue to alleviate or soften dynamic stall and experimental results will be used to modify current analytical techniques and to identify regimes requiring further investigation. The coupled rotor-body analysis will be improved and extended. Rotor configurations with potential for noise reduction and with minimum impact on performance will be tested in the 7 x 10 feet wind tunnel. Laser velocity measurements will be made on various centrifugal compressor impellers. The pressureless sintering process will be used to produce usable engine hardware made of high-temperature ceramics. Seals research will include the development of an advanced set of fretting criteria. Efforts will continue to apply the full three-dimensional non-lifting unsteady calculations to blades on non-rectangular geometries.

5. Program to Completion: This is a continuing program.

6. Major Milestones: Not applicable.

7. Resources ($ in thousands):

	FY 1977	FY 1978	FY 1979	FY 1980	Additional to Completion	Total Estimated Cost
RDTE,A Funds	4485	4950	5210	5700	Continuing	Not Applicable

Project: #BH57 Title: Research in Scientific Problems With Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DoD Mission Area: #110 - Defense Research Budget Activity: #1 - Technology Base

A. DETAILED BACKGROUND AND DESCRIPTION: This project supports research to increase knowledge in mathematics and the physical, engineering, environmental, and biological sciences directly related to long-term national security needs and to the solution of identified military problems. It provides part of the base for subsequent exploratory and advanced developments in Defense-related technologies and of new or improved military functional capabilities in areas such as communications, detection, tracking, surveillance, weapons, munitions, aircraft, missiles, propulsion, land vehicles, guidance and control, navigation, energy conversion, materials, armor, structures, military construction, and personnel support.

Physics research is directed to the discovery and exploitation of concepts, phenomena, techniques and data that can be expected to improve military weapons, equipment and practices. Emphasis is on surveillance, communications, weapons guidance, radar and ordnance. Research in chemistry contributes to the molecular technology base essential to solving the Army's requirements in camouflage, decontamination, development of high energy materials, and the synthesis of potting compounds, adhesives, and other new materials with special electrical, magnetic or optical properties. The mathematics program is guided by two objectives: advancement of mathematical concepts and tools that are a prerequisite for a strong technology base in ballistics, heat transfer, testing and computer software; and responsiveness to Army research, development and operational agencies in the solution of their critical problems. The electronics program is described in a separate descriptive summary. Geosciences investigations in the atmospheric and terrestrial areas provide the technology to meet the Army's goals for accurate weather information, adapting Army vehicles and military construction to the natural environment, improved mapping and navigation, improved trafficability and mobility, and operating in the severe desert-polar-tropical regions of the world. Biological sciences research in such areas as biochemistry and biophysics is directed toward maintaining the well-being of the soldier and the development of an adequate chemical and biological weapons defense capability. Metallurgy and materials research contributes materials for mobility, firepower, and personnel protection for the Army through exploration of novel phenomena and generation of new understanding of the processing, structure, properties, degradation and protection of materials. Research in mechanics and aeronautics covers the fields of solid mechanics, fluid mechanics and power generation with the objective of establishing a scientific base for improving performance and reliability while reducing cost and maintenance requirements of weapons, armor, structures, propulsion devices and ground and air mobility.

This project is divided into scientific areas as follows: 01-Atmospheric and Terrestrial Sciences; 02-Biological Sciences; 03-Communications Engineering and Electronics; 04-Materials; 05-Mathematics; 06-Mechanics and Aeronautics; 07-Physics; and 08-Chemistry. These broad groupings of research derive from the strong need of the Army to participate in and sponsor work in the scientific community for the development of new knowledge that contributes to the improvement of Army equipment.

B. RELATED ACTIVITIES: This program, which is completely extramural, is coupled with and related to in-house laboratory work in the Defense Research Sciences, and close coordination is maintained with both the administrators and bench scientists in the laboratories. The Navy, Air Force, National Aeronautics and Space Administration, Department of Energy, National Science

Foundation, Department of Interior, National Bureau of Standards, Department of Health, Education and Welfare, other government agencies, government agencies of allied nations, and the industrial community conduct related research. Coordination to assure no unnecessary duplication is accomplished by program reviews; exchange of program data sheets, research and technology resumes and technical reports; interservice and interagency liaison; and attendance and participation of Army representatives at annual reviews sponsored by the Office of the Under Secretary of Defense for Research and Engineering. Coordination occurs through sponsorship of meetings and conferences, attendance at professional and scientific society meetings and review of scientific literature.

C. WORK PERFORMED BY: This program of grants and contracts with academic and not-for-profit institutions and industrial laboratories is managed by the U.S. Army Research Office, Research Triangle Park, NC. The top five grantees and contractors are: Massachusetts Institute of Technology, Cambridge, MA; University of Wisconsin, Madison, WI; University of Illinois, Champaign-Urbana, IL; Stanford University, Stanford, CA; and University of Southern California, Los Angeles, CA. There are in addition 188 grantees and contractors. The value of the additional grants and contracts is $19,715,000.

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Simultaneous detection of atmospheric and ocean floor shock waves has been found to have the potentiality for early warning of ballistic missile launchings. Techniques have been developed which will greatly improve methods for evaluating the biological effects and hazards of microwave radiation. Advances in materials processing have improved reliability and reproducibility in casting of metals, stronger welds, protective coatings for turbine alloys, high-temperature turbine ceramics and graphite with electrical conductivity comparable to copper. New methods have been found for solving free surface and moving boundary problems, which arise in a variety of applications such as heat transfer in gun tubes, interior ballistics calculations, and fabrication of semiconductor devices and integrated circuits. A systematic and concise method has been developed for the analysis of helicopter rotor noise. A unique series of glasses have been discovered exhibiting electrochromism and photochromism, leading to the possibility of a completely solid state electrochromic display which may be fabricated in a wide variety of geometric configurations. Progress has been made in developing new routes to the synthesis of energetic nitro compounds having promise of reducing the enormous quantities of polluting by-products in the production of trinitrotoluene (TNT). Accomplishments in the electronics area are reported in a separate descriptive summary.

2. FY 1978 Program: The program is balanced between work responsive to a stated need, work which supports an ongoing program at an Army laboratory, and higher risk work directed to long-term potential contributions to future Army technology. The program in the electronics area is reported in a separate descriptive summary. Research in the areas partially listed here will provide the Army with the most advanced equipment and will enable it to be responsive to its changing needs: instabilities in solids; extension of the useful range of the electromagnetic spectrum; identifying the fundamental forces that govern the mechanical properties of metals and alloys; physical basis for exploitation of materials having unique properties; exploitation of new phenomena and invention of new device concepts with potential for dramatic improvements in command and control system

capabilities; application of structural dynamics to road vehicles, helicopters and gun barrels; aerodynamics of rotorcraft, fin-stabilized, powered and spin-stabilized bodies; ground engine and aircraft engine combustion; high energy, fire safety and storageability of fuels; explosive blast phenomena; high energy sources associated with weapon activation; degradation and reactivity of materials, with increased emphasis on erosion by hot gases; mechanical behavior of materials, especially under high rates of loading; initiation of chemical reactions; new techniques for sensing, detection, decontamination, and identification of chemical agents, pollutants and explosives; nonlinear analysis of unsteady phenomena; large-scale optimization; decision theory and modeling; lower and middle atmosphere sensing and composition; smoke, aerosol physics, and atmospheric transmission; sensing, mapping, terrain and geodetic studies; improved ration systems and logistics for enhanced storage life safety, nutritional quality and pest control; microbiological attack on materials; environmental quality, protection and rehabilitation; microwave biological effects; and physiology of soldier performance.

3. FY 1979 Planned Program: The FY 1979 program will be a continuation of the work described in section 2 above. The component of the program directed to long-term potential contributions to future Army critical technologies will be increased. In addition to the work described in a separate descriptive summary for the electronics program, research emphasis will be placed on carefully selected thrust areas including: new optical signal processing techniques for target identification and tracking; impact and penetration of armor; simulation, testing and analysis of materials; electrochemical energy conversion; software testing and reliability; mesometeorology; and biological and chemical warfare detection and protection. The planned increase over the FY 1978 level will maintain the current strong extramural research program and will provide $3,000,000 for a new program entitled, Defense Sciences and Engineering Program (DSEP). It is proposed to initiate DSEP in FY 1979 to apply new management techniques to support high-quality problem-oriented research at universities. Although DSEP will be part of the program managed by the Army Research Office (ARO), it will be different from the rest of the ARO program in that for an initial period the Office of the Under Secretary of Defense for Research and Engineering will provide direct oversight of DSEP to help guide the program and to assure coordination between the Army, Navy and Air Force. DSEP will be responsive to key Army as well as Department of Defense thrust areas for which research is needed to resolve scientific and technical uncertainties.

4. FY 1980 Planned Program: The FY 1980 program will be based on a continuation of the work described in the foregoing sections. The flexibility to initiate new thrusts as promising scientific areas and corresponding Army needs become evident will be maintained. The new Defense Sciences and Engineering Program with universities will be continued with increased funding.

5. Program to Completion: This is a continuing program.

6. Major Milestones: Not applicable.

7. Resources ($ in thousands):

	FY 1977	FY 1978	FY 1979	FY 1980	Additional to Completion	Total Estimated Cost
RDTE,A: Funds	23677	26576	31500	40000	Continuing	Not Applicable

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #03
Project: #BH57
Program Element: #6.11.02.A
DoD Mission Area: #110 - Defense Research

Title: Communications Engineering and Electronics
Title: Research in Scientific Problems with Military Applications
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

A. DETAILED BACKGROUND AND DESCRIPTION: The electronics and communications scientific area contributes to the technology base through the exploration of novel pheonomena and the generation of new concepts. The objective is to provide a science and technology base in selected areas of electronics and communications to help satisfy present and future Army requirements. Research to obtain fundamental information is performed in the areas of signal generation, transmission, reception and processing; computer systems and communication theory; solid state electronics to include semiconductors, magnetics and dielectrics; and circuitry and networks. Work under this task will find application to a wide variety of Army problems in communications, command and control; surveillance, target acquisition and night observation; and electronic warfare. The Army's Science and Technology Objectives Guide FY 1978 and Long Range Technical Forecast documents are used as a basis for selecting fundamental research to meet long range requirements. Medium and short range requirements are delineated from Army laboratory plans, personal contacts with Army scientists and engineers and careful study of the applicable technology base versus existing state-of-the-art of science and technology. The engineering oriented nature of this task provides for extraordinarily efficient technology transfer among the industrial, academic and military communities. Also, because of the close coupling between the staff of the Army Research Office's Electronics Division and appropriate Army laboratory staffs, a significant amount of work funded under this task is directly complementary to laboratory in-house efforts. Included is the Army portion of the support for the Joint Services Electronics Program, planned and funded jointly by the Army, Navy, and Air Force.

B. RELATED ACTIVITIES: This program is related to parts of the following projects iin Program Element 6.11.02.A: A31B, Night Vision Devices Research; AH47, Electronic Devices Research; AH48, Electromagnetic Propagation and Antenna Research; AH49, Missile and High Energy Laser Research; AH44, Research in Fluidics, Nuclear Effects and Ordnance Electronics; AH43, Research in Ballistics; and AH51, Combat Support Research. Close coordination is maintained with the Navy, Air Force, Defense Advanced Research Projects Agency, the National Aeronautics and Space Administration, and the National Science Foundation. Coordination meetings are held on a regular basis.

C. WORK PERFORMED BY: This program is managed by the US Army Research Office, Research Triangle Park, NC. The top five contractors are: Massachusetts Institute of Technology, Cambridge, MA; University of Illinois, Urbana, IL; Columbia University, New York, NY; Stanford University, Stanford, CA; and University of California, Berkeley, CA; The total number of additional contractors is 37; the total dollar value of these contracts is $2,200,000.

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Significant progress was made in advancing the state-of-the-art of electronic devices. During the past year the most accurate determination to date of the surface atomic structure of three important semiconductor surfaces was achieved; these materials are used extensively in the electronics industry, silicon being the principal semiconductor

device material. Theoretical predictions indicate that certain electron devices made with indium phosphide should outperform those based on gallium arsenide or silicon; recent results from this program proved several of those predictions to be true. There has been continuing development and improvement of a computer program which simulates and models the physical processes involved in the manufacture of integrated circuits. Theoretical research on electromagnetic propagation has found application to radiating elements in conformal arrays, ground wave propagation over uneven terrain, and radar scattering from the interior of open cavity structures such as jet engines. An important new theoretical result pertinent to the design of two-dimensional digital filters for signal processing was obtained; this result should find use in a number of Army applications. Major progress has been made in the development of intelligent optical tracking concepts that can be used to locate, recognize, and track a large class of targets in noisy background scenes. This research has contributed to the solution of three major problems: real-time image decomposition, real-time structural tracking, and real-time control.

2. FY 1978 Program: Efforts are continuing to optimize payoff from this contractual Army research program. An electronics advisory panel involving key Army managers and scientists from those Army laboratories having a primary involvement in electronics research has been established. This panel is providing for a more formal coordination of the total electronics efforts of the Army. The Army Research Office's Electronics Division now has responsibility for the Army management of the Joint Services Electronics Program and for FY 1978 has initiated new management procedures, adopted by Navy and Air Force, to improve the management and technical content of that tri-Service program. The following research areas are being emphasized: research in physical electronics, particularly on surfaces and interface states, which will have impact on most electronic devices of interest to the Army; research on electron devices that addresses Army barrier problems, e.g., transit time devices and millimeter wave devices; and research on antennas and propagation, with thrusts on electrically small antennas for Army vehicles and proximity effects of antennas with surrounding structures. In circuits and networks emphasis is on integrated circuit modeling and simulation to provide more effective and reliable large scale integrated circuits for Army systems; significant results from this program are already being adopted by the electronics industry. In the communications and signal processing area new research efforts to solve problems in communication in multi-signal environments will start; the commitment to all digital communications within the Army will require new technology base information. In the computer area, emphasis is on studies to improve the reliability and efficiency of Army electronics systems through improvements in computer subsystems; there is special interest in distributed computing architectures using microprocessors. Most of the increased funding for FY 1978 is being used for the above areas. One area of deemphasis is surface acoustic wave research where previous fundamental results are now in the development phase. The Joint Services Electronics Program at Columbia University, Massachusetts Institute of Technology, University of Illinois, Harvard University, Polytechnic Institute of New York, University of California-Berkeley, University of Southern California, University of Texas-Austin, and Stanford University is being continued at approximately the same level as FY 1977.

3. FY 1979 Planned Program: Most of the electronics areas described above will be continued, but with new research ideas in those areas being given greater consideration. It is planned to increase emphasis on research of a long-term nature during FY 1979, and to replace about 30% of the contracts active in FY 1978 with new efforts in order to keep the program dynamic relative to Army needs. During FY 1979 it is planned to explore expansion of funding for the Joint Services Electronics

Technical/Scientific Area: #03 — Title: Communications Engineering and Electronics
Project: #BH57 — Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A — Title: Defense Research Sciences
DoD Mission Area: #110 - Defense Research — Budget Activity: #1 - Technology Base

Program in those technical areas of major importance to the Department of Defense; this will require coordinated action with the Navy and Air Force. Also, three large block funded projects (one from each) of the Army, Navy, and Air Force known as Associated Joint Services Electronics Program contracts will be considered for inclusion in the Joint Services Electronics Program. The exact level of funding for any given research area will depend upon changing Army needs and the funding provided by other Army elements as well as by other agencies of the Department of Defense and the National Science Foundation.

4. FY 1980 Planned Program: The total electronics and communications research program of the Army will be assessed to determine the proper direction for the FY 1980 program. In general, the present program is designed to allow change of about one-third of the existing programs during each year. This kind of flexibility is desirable in case there should be significant changes in required technical thrusts. It is planned to continue increasing emphasis on research of a long-term nature during FY 1980.

5. Program to Completion: This is a continuing program.

6. Major Milestones: Not Applicable.

7. Resources ($ in thousands):

	FY 1977	FY 1978	FY 1979	FY 1980	Additional to Completion	Total Estimated Cost
RDTE,A Funds	5094	5269	5965	6440	Continuing	Not Applicable

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #AH60 Title: Research in Large Caliber Armaments
Program Element: #6.11.02.A Title: Defense Research Sciences
DoD Mission Area: #110 - Defense Research Budget Activity: #1 - Technology Base

A. DETAILED BACKGROUND AND DESCRIPTION: Research in Large Caliber Armaments supports the Army's armament development programs in scientific areas of unique Army need for fundamental understanding as a basis for sound future weapons and munitions development. It consists of research in the following scientific areas: energetic materials (explosives, propellants, and pyrotechnics); ultra-high pressure physics; and physics of armament (failure and reliability, advanced structural analysis, gun mechanism analysis, and control theory). In energetic materials, the thrust is toward developing new materials; understanding their behavior in ignition, initiation, combustion and detonation; and their effects and degradation to permit safer, more efficient and effective development, manufacture, use and disposal of munitions. The remainder of the effort is devoted to develop understanding of unique problems in armaments to permit the design of longer life, safer and more efficient gun tubes, recoil mechanisms and mounts.

B. RELATED ACTIVITIES: Related research is performed by the Navy, Air Force, National Aeronautics and Space Administration and the Department of Energy. Coordination is accomplished by program reviews, exchange of program data sheets, research and technology resumes, technical reports, and liaison and attendance at scientific meetings and conferences. At Department of Defense level, coordination is achieved through active participation in Joint Technical Coordinating Groups and program reviews sponsored annually by the Office of the Under Secretary of Defense for Research and Engineering. Broader, multinational coordination is achieved through joint participation of Australia, Canada, United Kingdom and the United States in The Technical Cooperation Program and by data exchange agreements on various aspects of the program. This project is closely coordinated with Project AH43, Research in Ballistics; Project AH61, Research in Small Caliber Armament; and program element 6.26.03.A, Large Caliber and Nuclear Armaments Technology. The objectives of this project are also supported by contracts and grants placed by the Army Research Office under Project BH57, Research in Scientific Problems with Military Applications.

C. WORK PERFORMED BY: This project is managed and directed by the Large Caliber Weapon Systems Laboratory at Dover, NJ. The in-house scientific efforts are performed at Large Caliber Weapon Systems Laboratory and Benet Weapons Laboratory at Watervliet, NY. Augmentation of the in-house effort is accomplished through contracts and grants with industry, universities, and other government agencies. Contracts of more than $25,000 are planned for National Bureau of Standards, Silver Springs, MD; Purdue University, Bloomington, IN; General Electric Corporation, Detroit, MI; University of Iowa, Iowa City, IA; and Lehigh University, Bethleham, PA. Sixteen additional contracts are planned totaling approximately $230,000.

Project: #AH60
Program Element: #6.11.02.A
DoD Mission Area: #110 - Defense Research

Title: Research in Large Caliber Armaments
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Three new analogs of tetranitroglycouril, a potentially cheap nitramine explosive or propellant, were synthesized and tested for improved hydrolytic properties. Nitramine pyrolysis studies and combustion modeling continued, in support of possible nitramine use in new low vulnerability and high-force propellants. Density as a function of pressure was obtained in argon to pressures exceeding 200 kilobars. A new activity was initiated to gain an understanding of the possible role of interfaces as a means of enhancing the fatigue and fracture behavior of materials. The effects of adding vanadium ions to standard chromium plating solutions was studied and measurements showed that the presence of vanadium ions suppressed the discharge of hydrogen during chromium deposition leading to crack free deposits of lower stress. Liners of gun steel and stellite were coated with tantalum using molten salt electrolysis. Using the chemical vapor deposition technique, preliminary runs on the coating of 20mm liners with tantalum have been successfully made. The mode of deformation of the rotating bands at the forcing cone was studied. High order isoparametric quadrilateral finite elements were studied for application to the elastic crack problem. New techniques were evolved to determine the parameters controlling pyrotechnic, propellant and explosive decomposition. Extensive work in high pressure experimental physics and fracture mechanics, motivated to understand phenomena occurring during firing in a gun tube has led, to important capabilities in fundamental physics. Static pressures in excess of 400 kilobars have been generated, and several new transition phases in bismuth have been discovered. A new technique for measurement of sound velocity in materials under ultra high pressures has been developed.

2. FY 1978 Program: Nitramine complexes are being studied for possible use in explosive/propellant formulations; and studies of mechanical properties of explosive and propellant compounds are beginning. Nitramine pyrolysis studies, ignition and combustion modeling, and investigations into the role of free radicals in explosive initiation are continuing. Additives to inhibit phase transitions are being sought. Studies are being undertaken in the palladium-silver-hydrogen system as both a carrier for atomic hydrogen and for possible high temperature superconductivity as an alloy. The development of a Meissner measurement technique is being completed, tested, and applied to bismuth and its alloys for very low resistance at high pressure measurements. Theoretical and experimental studies into possible techniques for the stabilization of useful high pressure phases are underway. As a contribution to the understanding of the phenomena of kinetic energy penetration, studies are being initiated into the development of experimental equation of state information on penetrator and armor materials to the 500 kilobars range. Experiments on the effects of electroactive chemical additions to rhenium plating solutions as a model for chromium are being initiated. Effect of nitrogen on the hot hardness of tantalum coating, applied by the chemical vapor deposition technique is being investigated. Design of coating/liner barrel combinations using such deposition techniques as chemical vapor deposition and fused salt electrolysis and the use of compressive residual stresses is being optimized to achieve maximum mechanical and thermal compatibility. Various geometries of rotating band-forcing cone systems are being simulated in the laboratory and studied for minimum engraving stress and maximum obturation. Work on the probabilistic models for gun tube fatigue is being completed. The experimentally determined criterion for crack arrest is being refined for bi-metal interfaces and characterized in terms of fracture mechanics concepts. The design methodology for the adaptive recoil mechanism is being refined and upgraded using statistical techniques.

Project: #AH60 — Title: Research in Large Caliber Armaments
Program Element: #6.11.02.A — Title: Defense Research Sciences
DoD Mission Area: #110 - Defense Research — Budget Activity: #1 - Technology Base

3. FY 1979 Planned Program: It is planned to synthesize novel nitrated compounds; continue work on propellant surveillance tests; and continue studies of nitramine complexes, mechanical properties, nitramine pyrolysis studies, and free radical investigations. Computer codes for investigation of deflagration-to-detonation transition (DDT) in collapsing flames will be developed. Studies of hydrogen both as a condensed molecular phase and in the palladium hydride system will be extended beyond the 500 kilobars region. Alloying and kinetic studies will be undertaken to stabilize high pressure phases, considering first bismuth, if studies show the new phase exhibits high temperature superconductivity under pressure. Studies of the pressure synthesis of alkaline halides and rare earth fluorides will continue for low absorption materials in the short wavelength range. Liners with and without coatings will be fabricated and test fired for erosion resistance and accuracy. Selected geometries of rotating band-forcing cone system, will be further optimized to achieve minimum stresses at the forcing cone. Multiple radial cracks of unequal lengths in a pressurized cylinder will be studied and the effect of many shallow cracks on the stress intensity factor of a deep radial crack in a gun tube will be determined. Increased funding is provided to emphasize research in ignition and combusion of solid propellants. This program involves 57 professional and 24 support personnel.

4. FY 1980 Planned Program: New thermally stable explosive will be synthesized, and work will continue on: surveillance tests, nitramine complexes and pyrolysis studies, mechanical properties, modeling, and free radical mechanisms. Efforts will concentrate on characterizing and exploiting defects for possible extension of the superconductivity range. New studies will be undertaken to exploit ultra-high pressure for the synthesis of new energetic materials. Alloy plating experiments will be conducted on chromium and rhenium in the presence of electroactive chemical additions. Effect of impurities on the high temperature mechanical properties of tantalum and columbian alloys will be investigated. Further studies to characterize the transition from laminar to turbulent flow of compressible fluids flowing through variable orifices will be conducted. Funding increase is provided to improve understanding of the fundamental processes in ignition, combustion, and detonation.

5. Program to Completion: This is a continuing program.

6. Major Milestones: Not applicable.

7. Resources ($ in thousands):

	FY 1977	FY 1978	FY 1979	FY 1980	Additional to Completion	Total Estimated Costs
RDTE,A Funds	4944	5000	5160	6000	Continuing	Not Applicable

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #BS01 — Title: Basic Research on Military Injury and Diseases
Program Element: #6.11.02.A — Title: Defense Research Sciences
DoD Mission Area: #110 - Defense Research — Budget Activity: #1 - Technology Base

A. DETAILED BACKGROUND AND DESCRIPTION: Basic research utilizes new and classical techniques of immunochemistry, histopathology, serology, immunology, microbiology and epidemiology on infectious diseases with existing or potential effect on military operations, such as meningococcal diseases, arbovirus diseases, and parasitic diseases. Enteric studies are directed toward better understanding of basic pathogenesis and militarily unique aspects of viral and bacterial infections. Problems of the combat soldier include fundamental studies in areas of shock, burns, nervous system injury, pulmonary complications, blood replacement, sepsis, wound healing and evaluation of current methods of treatment. Additional studies include biomedical factors associated with psychiatric ineffectiveness in the Army. Worldwide information on the distribution, ecology, taxonomy, and control of arthropod vectors of disease is developed in order to provide the epidemiological data base necessary for further progress in the health of Army personnel.

B. RELATED ACTIVITIES: Related work is performed under program elements/Army projects 6.11.02.A/BS02, Basic Mechanisms of Recovery from Injury; 6.11.02.A/BS03, Medical Defense Against Biological Agents; 6.11.02A/BS05, Military Burn Research; 6.27.70.A/AB02, Military Preventive Medicine and Tropical Diseases; 6.27.70.A/AB03, Drug Development; and 6.27.72.A/A810, Military Skin Diseases. The Navy conducts related research under program elements/Navy projects 6.11.53.N/4105 and 4109 and 6.27.58.N/A009, Medical Research; and 6.27.06.N/5002, Medical Development. Other related research is conducted by the Air Force, National Institutes of Health and US Department of Agriculture. The related research is coordinated by means of project officer visits, committee meetings of the military services and national health agencies, exchange of reports, review of research and technology summaries, symposia on specific subjects, and periodic program reviews.

C. WORK PERFORMED BY: The work is conducted by in-house laboratories at Walter Reed Army Institute of Research, Washington, DC, and affiliated field units in Thailand, Malaysia, and Brazil; and by universities, not-for-profit organizations and industry through contracts and grants. Among the large contracts are those with Mount Sinai School of Medicine, New York, NY; Baylor College, Houston, TX; Cornell University, New York, NY; University of Michigan, Ann Arbor, MI; and University of Hawaii, Honolulu, HI. Sixteen other contracts are also funded under this project for a total of $1,700,000.

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Developed control strategy for selected arbovirus diseases based on information of insect bionomics; i.e., the control of overwintering infected mosquitoes prevents or reduces incidence of the disease in the spring. Spraying of selected areas with insecticides controls transovarially-infected mosquito eggs, thus reducing viral disease transmission. The basic epidemiology of hepatitis, dengue, and Japanese B encephalitis was studied in Thailand, with emphasis on improved methods of virus isolation and serological detection. A mouse screening system was established for the testing of candidate antischistosomal drugs. A serological test for cutaneous leishmaniasis infections was perfected. Advances were made in the studies of the immunology of scrub typhus, including an understanding of the rickettsia-mite relationship and the

establishment of primate models of human disease. Techniques were adopted for use in serologic diagnosis of rickettsial disease. Immunity to schistosomiasis in rats has been shown to be transferable by both antibody and lymphocytes. A successful snail colony with schistosomal infection has been established which is necessary for further drug testing studies against this disease. A new method has been devised for the rapid identification of rubella virus. A unique crystallization procedure was developed which simplified identification of hosts from mosquito blood meals. A new system was developed for mass isolation of infected Anopheles mosquito salivary glands in order to obtain large numbers of viable malaria sporozoites. Psychiatry research in biomedical science was directed at description of functional relationships between environmental factors in behavioral, neuroendocrinological, psychological and psychiatric variables. In the attainment of behavioral change, it was found that informative feedback signaling the correctness of each appropriate response greatly facilitates the acquisition of an entirely new pattern of responses. Behavior in an adversive situation is not simply a reflection of the current stress to environment, but is a consequence of the adversive situation imposed without prior preparation to adjust to it behaviorally. Shigella toxin was purified, characterized, and its mode of action determined as a preliminary step in vaccine development. Group B meningococcal cell wall fractions were studied as possible vaccine precursors. Microaggregates in stored blood are not responsible for the respiratory distress observed during resuscitation of shock patients.

2. FY 1978 Program: Animal models currently under development are being completed; these include cutaneous leishmaniasis in mice and visceral leishmaniasis in primates. Selective methods for modifying the response of immune mechanisms to foster wound healing and to prevent graft rejection are being developed. Emphasis is continuing toward gathering immunologic and pathogenic information about militarily important diseases such as dengue, scrub typhus, leishmaniasis, trypanosomiasis, and respiratory diseases to build a data base to permit further vaccine development. Investigations are continuing on development of worldwide information on the ecology, biosystematics, distribution, and control of arthropods involved in transmission of diseases affecting military personnel. Research is continuing on the development of methods and procedures for infectious diseases diagnosis, prevention and treatment. Studies on pathogen-vector species relationships are being continued. New and improved insect control procedures are being evaluated. Studies continue to elucidate the time course of bodily responses to stress and to develop behavioral principles. The complex internal-external interactive responses of humans to stress can most efficiently and effectively be studied with a background of behavioral and physiological principles developed through animal models. Pulmonary and gastrointestinal circulation studies are continued in an effort to determine the cause of post resuscitation complications in shock patients. In-house research programs are being initiated to study the biomedical effects, both auditory and non-auditory, of weapons-generated blast overpressures.

3. FY 1979 Planned Program: Research will continue to be directed toward gastrointestinal diseases of military importance, particularly on diarrheal disease, Salmonella and Shigella. Factors involved in directing the responses of lymphocytes in injury, infections, wound healing and tissue rejection will be studied. Basic psychiatric research will continue to provide the necessary data base for interpretation of military field studies and recommendations for prevention and/or treatment of breakdown in soldiers. Basic serological and biosystematic studies on arbovirus and malaria vectors of tropical areas will be completed. Field studies to determine the genesis of arthropod-borne viral epidemics will continue. Immunochemical investigations of cell surface

antigens of anerobic bacteria infections will be studied. The physiology of shock and methods of resuscitation will continue under investigation. Research in biomedical effects of blast overpressure will be directed toward improving hazard assessment and protective measures. The increase is due to the addition of funds to augment research efforts on the medical effects of blast overpressure.

4. FY 1980 Planned Program: Studies will continue on the basic immunology and pathology of dengue, scrub typhus, trypanosomiasis and other infectious diseases of military importance. Necessary basic studies on diarrheal diseases of the field soldier will continue toward development of a vaccine. Human immune reactions during injury, wound healing and infections will continue. Psychiatric studies providing essential data for prevention and/or treatment of the combat soldier under stress will continue. Basic control technologies of arthropod vectors of disease will be studied to effectively develop pest management systems that are effective in reducing diseases of military importance. Studies will continue to be directed toward prevention of and recovery from shock. Blast overpressure research will continue to assess biomedical effects and generate an adequate data base for validation of standards.

5. Program to Completion: This is a continuing program.

6. Major Milestones: Not applicable.

7. Resources ($ in thousands):

	FY 1977	FY 1978	FY 1979	FY 1980	Additional to Completion	Total Estimated Cost
RDTE,A Funds	7558	8373	10010	11226	Continuing	Not applicable

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.21.05.A
DoD Mission Area: #151 - Materials and Structures

Title: Materials
Budget Activity: #1 - Technology Base

A. [redacted] (PROJECT LISTING) ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	9879	11205	11275	12015	Continuing	Not Applicable
AH84-01	Advanced Materials for Aircraft	2322	1771	2139	2019	Continuing	Not Applicable
AH84-02	Advanced Materials for Armament	2203	2378	2478	2662	Continuing	Not Applicable
AH84-03	Armor	1442	1959	1815	2128	Continuing	Not Applicable
AH84-04	Advanced Materials for Missiles	632	711	831	1101	Continuing	Not Applicable
AH84-05	Mechanics of Materials	958	862	926	979	Continuing	Not Applicable
AH84-06	Advanced Materials for Solution of Special Problems	879	1643	1576	1744	Continuing	Not Applicable
AH84-07	Advanced Materials for Laser Hardening	929	890	569	376	Continuing	Not Applicable
AH84-08	Advanced Materials for Ground Combat Vehicles	514	991	941	1006	Continuing	Not Applicable

Program Element: #6.21.05.A
DoD Mission Area: #15i - Materials and Structures

Title: Materials
Budget Activity: #1 - Technology Base

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The work under this program is exploratory development of improved and advanced materials directed primarily toward four generic Army weapon systems and their missions: aircraft, armament, ground combat vehicles and missiles. The remainder will address special problems with varied requirements for materials technology. The objective of the program is to conduct exploratory development to produce improved materials and processes for use in the design, construction and operation of Army weapon systems to satisfy superior tactical and strategic performance requirements and reduced life cycle costs. Specific Army need is reflected in the following examples: accelerated wear of gears and drive train components of Army helicopters causing frequent overhauls, limited performance life and high costs of operation and maintenance; excessive wear and erosion of gun tubes with resultant short barrel life, inaccurate ballistics performance and high operational costs; current inventory of ground combat vehicles fabricated of hull and armor materials incapable of defeating long rod/high density penetrator munitions threat; high vulnerability of crew and personnel of ground combat vehicles to wide-angle backface spall caused by anti-armor munitions; limited capability of missile radome materials traveling at high mach numbers to withstand rain erosion and maintain good electromagnetic transmission properties; limited capability of current weapon system materials to provide adequate protection against high energy laser threats; and lack of acceptable levels of reproducibility of ballistics performance of high density penetrator munitions due to inadequate advanced penetrator core materials.

C. BASIS FOR FY 1979 RDTE REQUEST: Work will be conducted to overcome mission deficiencies and satisfy mission needs outlined in paragraph B and to exploit technological opportunities in advanced materials development. It will consist of development of improved materials and processes for evaluating and improving the mechanical, thermal, and fatigue properties and the resistance to erosion and corrosion of lightweight, high strength alloy systems, reinforced composite, advanced ceramics, adhesives for bonded joints, and coating materials for corrosion prevention. Major thrusts will include development and characterization of high strength-light weight materials to provide increased mobility/maneuvarability for ground combat vehicles and Army helicopters: improved materials and advanced armor to defeat penetrator munitions; high-strength/toughness alloys for gun barrels that shoot farther and maintain their accuracy longer; high modulus-light weight materials to withstand high G forces of advanced missiles; significantly improved materials to satisfy increasing demands of helicopter drive train components to increase time between overhaul and reduce cost of maintenance/overhaul; and innovative new materials and materials processes for weapon system failure analyses and reparation. The overall objective will be to develop and characterize new and improved materials specimens to provide life cycle cost reduction, needed improvements in weapon system performance and reliability, and significantly reduced maintainability.

Program Element: #6.21.05.A
DoD Mission Area: #151 - Materials and Structures

Title: Materials
Budget Activity: #1 - Technology Base

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The work in this program element is a part of a three-part research, exploratory development and advanced development program for materials. The goals of this program are to produce new materials products, new materials specifications and prototypes specimen made of new materials. Applied research and exploratory development are conducted in the following areas: metallurgical techniques and alloy improvements; organic materials; ceramic materials; composite materials; mechanics of materials; laser hardening of materials; and test evaluation methods. All these efforts are aimed at producing improved materials for use in the design, construction of operation of Army materiel to satisfy superior performance requirements, to reduce costs of weapon systems acquisition and lifetime ownership cost of weapon systems.

F. RELATED ACTIVITIES: The Navy, Air Force, other Government agencies, and allied nations have complementary programs in one or more of these materials areas. Coordination within the Department of Defense is achieved through bi-annual update of the Materials Technology Coordinating Paper and meetings of the Office of the Deputy Under Secretary for Defense Research and Engineering ad hoc Services Materials Laboratories Council. Coordination with the non-military federal agencies is effected through participation in activities of the National Materials Advisory Board of the National Academy of Sciences -- National Academy of Engineering and the Interagency Council on Materials, and with the US Department of Energy. International coordination is effected through participation in the Technical Cooperation Program with Australia, Canada, New Zealand, and the United Kingdom and the Structures and Materials Panel of the Advisory Group for Aerospace Research and Development of the North Atlantic Treaty Organization.

G. WORK PERFORMED BY: Approximately 75% of the work will be accomplished in-house at the Army Materials & Mechanics Research Center, Watertown, MA; US Army Armament Research & Development Command, - Dover, NJ, Natick Research & Development Command, Natick, MA; US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA; and the US Army Missile Research and Development Command, Huntsville, AL. Typical contractors are: AVCO, Everett, MA; Massachusetts Institute of Technology, Cambridge, MA; Stanford Research Institute, Palo Alto, CA; Desert Sunshine Corporation, Phoenix, AZ; Georgia Institute of Technology, Atlanta, GA; University of Illinois, Urbana, IL; US Steel Corporation, Pittsburg, PA; Rockwell International, Thousand Oaks, CA; and Iowa State University, Ames, IA.

Program Element: #6.21.05.A
DoD Mission Area: #151 - Materials and Structures

Title: Materials
Budget Activity: #1 - Technology Base

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Accomplishments include implementation of new characterization techniques for composite helicopter blade materials; identification of causes for unacceptable variability of tungsten penetrator ballistics performance and recommendation of corrective action; development and recommendation of armor materials/design for improved TOW vehicle; improvement of materials for blast resistant tank track program; development and evaluation of new composite materials joint designs for mobile military bridging. Prototype Army Helicopters engine blades were fabricated from high strength, high temperature filament reinforced superalloy composites. Enhancement of aluminum and steel armor against both anti-personnel projectiles and munition fragments by incorporating Kevlar spall-suppression backup liners; development of a phosphazene rubber quick-disconnect gasket for refuel operations in arctic climates; developed camouflage coating materials for PARTIOT radar antenna elements.

2. FY 1978 Program: Development of improved polymeric, ceramic and composite materials, alloys of aluminum, titanium and uranium; determinations of fatigue, fracture, corrosion, stress corrosion, environmental deterioration, biodegradation and fungal attack of military materials; the development of high density projectile munition materials, fragmenting munitions materials investigation of structural and radome materials with laser hardening characterics; further development of electroslag remelted and maraging steals; development and application of techniques for coatings for radar camouflage and for the prevention of erosion, corrosion and environmental deterioration; development of lightweight materials and design requirements for rapidly deployable combat bridging; and determination of laser protection levels provided by basic combat uniform materials.

3. FY 1979 Planned Program: Develop new high temperature alloys and composites, upgrade the corrosion and high temperature properties of coatings, and improve stress and fatigue properties all to satisfy requirements for improved combat vehicle engines. Improve processing procedures for helicopter gear and bearing materials. Correlate high density munition materials properties and processing conditions with reproducible ballistic performance. Performance of improved steel powders for fragmenting munitions will be determined under various stress and strain rates. Evaluation of layered coating for improving wear and erosion resistance of small arms gun tubes. Mathematical and experimental parameter determinations of the combined performance of foamed material layers and armor plates subjected to mine blast. Light-weight materials for vibration, fatigue, and noise reduction for advanced combat vehicles. Advanced ballistic protection materials for modified tank track suspension systems will be developed and evaluated. Work to provide microstructural integrity of fused silica, testing and evaluating improved radome and nose tip materials, processing and fabricating techniques, and thermal battery materials - all for advanced Army missile sytems. Investigation of the effect of humidity and temperature on the stress corrosion cracking of critical weapon systems components will continue. Mechanisms of environmental deterioration in organic composite materials will be determined and agents developed for retarding degradation. Flammability characteristics of organic materials will be evaluated. Work will be initiated to optimize laser protection with ballistic and structural performance. Developmental of laser resistant transparent blast shields for Army Attack Helicopters.

Program Element: #6.21.05.A Title: Materials
DoD Mission Area: #151 - Materials and Structures Budget Activity: #1 - Technology Base

4. FY 1980 Planned Program: Continue the development of new alloys for high temperature applications, development of composite components, hot corrosion resistant coatings and stress analysis procedures for combat vehicle engines. Weapon systems structural work will concentrate on the rheocast fabrication process, on evaluating environmental effects on magnesium protective coating systems and on adhesive bonding. Correlate structural properties and component performance on gear and bearing materials. Specimens of penetrators materials of extruded Uranium and Tungsten alloys will be fabricated and tested. Fragmentation tests of cylinder materials machined from 105mm and 155mm projectiles. Effects of thermal stresses and various gaseous environments on cracking nucleation and crack propagation in layers formed in gun tube specimens will be investigated. Textured materials for armor application will be subjected to ballistic examination and analysis. Aircraft systems work will be extended to powder metallurgical processes with aluminum alloys and strain hardenable Al-Mg-Li alloys. Assessment and design guides for use of foamed materials to reduce mine blast damage to armor vehicles will be developed. Fire-resistant and fire-barrier armor materials construction for ground combat systems applications will be developed and evaluated. Work will continue on microstructural analyses of fused silica, rain erosion resistance of silicon nitride, fabrication techniques and the improvement of thermal battery materials. Effects of humidity and temperature on stress corrosion cracking of stored missiles will be determined for a series of steel and aluminum alloys. The bridging materials program will be oriented to fiber reinforced organic composite materials lightweight metallic components and design of shafting, truss and coupling members. Development of rapid cure techniques for thermosetting resin-based composites, investigation of continuous fiber reinforced thermoplastics and utilization of structural foams as lightweight impact resistance components. Improved prototype tank treads materials will be developed and evaluated. Effects of tropical environments on new lightweight magnesium alloys will be evaluated. Prototype thermoplastic foam/chopped Kevlar fiber-reinforced epoxy combat vehicle track components will be developed.

5. Program to Completion: This is a continuing program.

FY 1979 RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.21.11.A
DoD Mission Area: #134 - Environmental Sciences

Title: Atmospheric Investigations
Budget Activity: #1 - Technology Base

A. RESOURCES(PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL PROGRAM ELEMENT	3989	5340	5703	6100	Continuing	Not Applicable
AH71-01	Automatic Meteorological Technology	972	1040	1520	1335	Continuing	Not Applicable
AH71-02	Meteorological Satellite Techniques	1169	570	363	510	Continuing	Not Applicable
AH71-03	Atmospheric Sensing and Techniques	1158	2650	3150	3520	Continuing	Not Applicable
AH71-04	Atmospheric Environment of Military Systems	515	880	570	585	Continuing	Not Applicable
AH71-05	Meterology of Transport and Diffusion	175	200	100	150	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Develop (1) remote atmospheric sensing equipment for weapons fire control systems, (2) automated meteorological products for tactical Army weather intelligence, (3) predictive transport/diffusion models for battlefield smoke/obscuration development/testing/employment, (4) predictive atmospheric models for Ballistic Missile Defense/Army communications systems, (5) meteorological satellite techniques for battlefield severe weather location, (6) improved sound ranging algorithms and software techniques for artillery locating systems and (7) Electro-Optical (E-O) transmission models for use by E-O weapon systems.

C. BASIS FOR FY 1979 RDT&E REQUEST: Field measurements will be conducted to characterize the atmosphere for E-O weapon and smoke systems. A smoke/obscuration model will be completed and utilized to predict capabilities/limitations of electro-optical surveillance systems under low visibility battlefield conditions. An exploratory development model of the pulsed laser remote crosswind sensor for Armor (tank) operation will be completed and provided to users. World data maps of D-region electron density will be prepared and the results applied to improvement of current electromagnetic prediction techniques used by the US Army Communications Command.

D. OTHER APPROPICATION FUNDS: Not Applicable.

Program Element: #6.21.11.A
DoD Mission Area: #134 - Environmental Sciences

Title: Atmospheric Investigations
Budget Activity: #1 - Technology Base

E. DETAILED BACKGROUND AND DESCRIPTION: This program determines atmospheric effects on Army weapons systems and field operations and develops equipment/techniques to predict, circumvent and/or mitigate the impact of the atmosphere on these systems. Equipment/techniques are developed to increase the accuracy/operation and survival of weapon systems and increase the effectiveness of battlefield operations. Work concentrates on: (1) development of atmospheric sensors/models/techniques required in direct support of tactical battlefield messages for battlefield commanders and weapons systems; (2) development of automated techniques for battlefield meteorological information and intelligence displays/messages for battlefield commanders and weapon systems; (3) determination and prediction of the atmospheric environment (including natural and nuclear) likely to be encountered by Ballistic Missile Defense and Army communication systems; (4) provide prediction capabilities of chemical, biological, obscuration and air pollution materials for Intelligence Preparation of the Battlefield (IPB), Chemical Corps, Program Manager-Smoke, and the US Army Surgeon General Environmental Health Agency; (5) apply meteorological satellite data to Army operations and weapons systems, and (6) determine the atmospheric effects on the propagation of electro-magnetic energy and of smoke and natural atmospheric aerosols on electro-optical weapon systems.

F. RELATED ACTIVITIES: Program Element 6.11.02.A Atmospheric Sciences, and 6.37.41.A Meteorological Equipment Development. Work is coordinated within the Department of Defense by the Under Secretary of Defense for Research and Engineering (USDRE). USDRE coordinates with the Interdepartmental Committee on Applied Meteorological Research. Direct coordination at all echelons as well as cooperative programs are conducted. For example: Cooperation between the Meteorology Division, Dugway Proving Ground, Utah, and the National Oceanographic and Atmospheric Agency (NOAA), Environmental Protection Agency (EPA), National Aeronautical and Space Administration (NASA), and the Army Project Manager Smoke/Obscurants on prediction of the transport and diffusion of atmospheric aerosols, particulates and smoke; cooperation by the Atmospheric Science Laboratory with the Air Force in field experiments and in the development of new meteorological equipment and techniques; investigations of the ionosphere and its effects on anti-ballistic missile systems and communications blackout are coordinated with the Air Force, the US Army Communications Command and the Defense Nuclear Agency; meteorological satellite research through the Joint Environmental Satellite Coordinating Group, and directly with Air Force, Navy, NOAA, and NASA; international coordination through participation in the Quadripartite Working Group/Meteorology and Panel XII (Meteorology) of the NATO Army Armaments Group.

G. WORK PERFORMED BY: Approximately 62 percent of the work is accomplished in-house at the US Army Atmospheric Sciences Laboratory, White Sands Missile Range, NM, and Dugway Proving Ground, UT. Out-of-house effort totals $2,134,000. Of this, $140,000 will be transferred to the Army Research Office, Durham, NC, to support unsolicited research grants with academic institutions. Contracts will total $1,994,000. Personnel involved in this program total 40 professional and 25 supporting.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: The initial Automatic Meteorological System-Artillery (AMS-A) for Corps Tactical Fire Direction System was completed and delivered to Project Manager, Army Tactical Data Systems (ARTADS). AMS-A will provide

increased accuracy/lethality/survivability for the Artillery. The Remote Automatic Weather Station (RAWS) system Letter of Agreement between Defense and Readiness Command and Training and Doctrine Command was approved and a Technical Data Package for Advanced Development was completed. RAWS will provide required Intelligence surface meteorological measurements in remote, target, and enemy areas. An experimental prototype pulsed laser remote crosswind sensor was developed. Miniaturization of the passive remote crosswind sensor was accomplished. This program has potential for application not only to the tank but to infantry anti-tank/anti-armor weapons. Temperature and density departure tables suitable for both ballistic and computer meteorological messages were completed for Central Europe and for Fort Carson, CO and disseminated for use by Army Artillery units in the field in these areas. Data collected for middle and high latitudes for low sunspot years were used to evaluate the US Army Communications Command (USACC) propagation model. The USACC model was found adequate for night-time predictions but requires improvements to satisfactorily predict day-time conditions.

2. FY 1978 Program: A transport and diffusion model is being completed and used in the preparation of battlefield smoke munition expenditure tables. A remote sensor for use with helicopter armament system is being flight tested. The sensor provides aiming corrections to compensate for wind effects at extended standoff ranges with reduced exposure time which will increase firing accuracy and aircraft survivability. An experimental prototype ceiling and visibility sensor is being evaluated prior to field testing. Critical atmospheric measurements of ceiling and visibility are essential to Army Aviation and Air Force users. Technical specificiations to integrate this sensor into the Remote Automatic Weather Station (RAWS) system is being designed. Field measurements are being made to characterize the atmosphere for electro-optical and smoke systems. A library of electro-optical transmission models for application to weapon systems is being established. Results of sound ranging capability over 10 km are being investigated and provided to the Artillery.

3. FY 1979 Planned Program: A smoke/obscuration model will be completed to include obscuration at infrared as well as visible wavelengths and microscale transport and diffusion processes for determining smoke dispersal. Field measurements will be provided for atmospheric conditions characterizing natural and specific artificial low visibility conditions during electro-optical sensor systems tests. Atmospheric effects will be investigated in propagation of electro-magnetic (EM) energy and of smoke and aerosols pertaining to degradation effects on electro-optical sensors. Prototype ceiling and visibility sensors incorporated in the Remote Automatic Weather Station system will be fabricated and tested for use by Intelligence and Aviation. These efforts address Army requirements for automated meteorological measurements in remote or "silent areas." Techniques will be developed for detecting and classifying severe storms over a battlefield using meteorologicial satellite sensors. An exploratory development model of the pulsed laser (10.6mm) remote crosswind sensor for Armor (tank) operations will be completed and provided for use in the fire control facility of the main battle tank. Systems will be evaluated for remote measurements of optical turbulence and crosswind along horizontal and slant paths. These data are required for High Energy Laser Systems Test Facility test scenarios. Field experiments to validate Radio Frequency (RF) propagation prediction techniques applicable to Army transmitters and receivers will be started. Funding increase in FY 1979 over FY 1978 of $363,000 is for: increased efforts addressing impact of natural and artificial (smoke) constituents of the atmosphere on electro-optical weapons systems/devices. New efforts in the program include temperature/density departure tables for Western

Russia for artillery fire; helicopter icing investigations, especially for Northern Europe in winter; and investigations of meteorological influences on long-range artillery rocket systems. Work will be completed on temperature density departure tables for Western Europe and on the portable, light-weight upper air sounding system for use with the Field Artillery Meteorological Acquisition System (FAMAS) now in 6.4 Engineering Development phase.

4. FY 1988 Planned Program: Low visibility battlefield smoke/obscuration model will be validated during field tests. The model will then be installed in a tactical computer, with input/output and graphic displays specifically tailored to individual user battlefield requirements. Meteorological/optical characterization support will be provided for electo-optical (E-O) systems field tests, such as those used in precision guided munitions. The ceiling and visibility sensor integration specification for the Remote Atmospheric Weather Station (RAWS) application, based on completed results of testing will be finalized. Field experiments to validate radio frequency propagation prediction techniques applicable to Army transmitters and receivers will be initiated. Preparation of world data maps for D-region electron density will be completed and results applied toward improving High Frequency prediction codes of the US Army Communications Command. Temperature and density tables for Western Russia will be completed and disseminated for use by Army Artillery units.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.21.20.A
DoD Mission Area: #152 - Ordnance Technology

Title: Nuclear Weapons Effects, Fluidics
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7883	8275	5788	7124	Continuing	Not Applicable
AH25-01	Nuclear Weapons Effects Research	7000	7275	4978	6124	Continuing	Not Applicable
AH25-02	Fluidics Technology	883	1000	810	1000	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Secretary of Defense in a report to Congress on the Theater Nuclear Force Posture in Europe, in 1975 stated that theater nuclear forces must be sufficiently survivable to have a credible retaliatory capability and secondly, that NATO conventional forces should be able to operate satisfactorily in a nuclear environment. To meet these requirements, a Nuclear Weapons Effects Research program to assure the survivability of Army materiel during and after a nuclear exchange is required. Environmental definition, hardening assessment, development of hardening fixes, and evaluation of the nuclear survivability of operational forces are parts of the program. The fluidic technology program provides a coordinated, Army-wide program for the design, development, testing and feasibility demonstration of fluidic systems for use in Army materiel. Fluidic systems offer the potential of greatly improved reliability, availability and maintainability and reduced life-cycle costs while providing improved end-item performance.

C. BASIS FOR FY 1979 RDTE REQUEST: Nuclear hardening of critical Army equipment is essential to mission accomplishment. The approach is to evaluate and improve nuclear survivability of critical fielded tactical systems to develop cost-effective hardening techniques for systems in development, to transfer the technology to system developers, and to evaluate the effectiveness of hardening on fighting unit survivability. Hardening fixes for critical equipment from the forward edge of the battle area through Corps will be available in FY 1979. Technology will be developed to insure that hardness is maintained during production and fielding of systems. Tests of fluidic controls for diesel engine fuel control, and back-up fuel controls for high mobility

combat vehicles will be initiated. Feasible fluidic suspension system components will be fabricated and tested. An inter-lock traction transfer system for tactical wheeled-vehicles will be evaluated. Program coordination, critical component development, and reliability programs will continue.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The nuclear weapons effects (NWE) research program is an integral part of the Army Nuclear Survivability Program. The NWE research program is structured to provide adequate environmental definition for all nuclear weapon effects; to develop appropriate hardening fixes; to provide technology for including nuclear survivability hardening during design and testing of systems in development. This is the Army's only program to provide the technology that enables development of equipment that will be survivable on the tactical nuclear battlefield. Fluidics offer low cost, high reliability, intrinsicly safe control systems that can operate in harsher environments than other controls, adaptive suspension systems for vehicles, and fuze-arming controls. This Program accomplishes these advanced development efforts, developing candidate systems enough to demonstrate the feasibility of transfering to system development as cost-effective improvements.

F. RELATED ACTIVITIES: Nuclear weapon effects research is part of a Tri-Service effort in coordination with the Defense Nuclear Agency. It is a vital and essential part of the Army Nuclear Survivability Program. It is related to Program Element (PE) 6.36.04 (Advanced Weapons Effect and Nuclear Munitions), D153 (Nuclear Effects Support Team), which provides for technological assistance to materiel development agencies. All appropriate programs for missiles, combat vehicles, command control and communication systems, and battlefield intelligence systems are supported by these efforts. Fluidic technology follows up on research in PE 6.11.02.A, Research in Fluidics, Nuclear Effects and Ordnance Electronics. The program leads into PE 6.31.03.A, Fluidics Advanced Development. Additionally, it supports the work of the Joint Technical Coordinating Group - Fluidics.

G. WORK PERFORMED BY: Harry Diamond Laboratories, Adelphi, MD; Ballistic Research Laboratory, Aberdeen Proving Ground, MD; US Army Electronics Research and Development Command, Fort Monmouth, NJ; US Army Missile Research and Development Command, Redstone Arsenal, AL; White Sands Missile Range, NM; US Army Tank Automotive Research and Development Command, Warren, MI; Air Mobility Research and Development Laboratory; Fort Eustis, VA; US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA. Contractors include General Electric, Schnectady, NY; AVCO, Wilmington, MA; University of Florida, Gainsville, FL; Shock Hydrodynamics, Ventura, CA; Physics International, San Leandro, CA; GTE Sylvania, Needham, MA; Science Applications, La Jolla, CA; Kaman Sciences Corporation, Colorado Springs, CO; Mission Research Corporation, San Diego, CA; Kaman Avidyne, Boston, MA; Braddock, Dunn and McDonald, Albuquerque, NM; Unidynamics, Phoenix, AZ; Northrop Corporation, Hawthorne, CA; Denver Research Institute, Denver, CO; Lovelace Foundation, Albuquerque, NM; EDX Engineering Incorporation, Wayne, NJ; Martin-Marietta Corporation, Orlando, FL; Bendix Corporation, Detroit, MI; Honeywell, Minneapolis, MN; AiResearch Manufacturing Company, Phoenix, AZ; and Try-Tec Corporation, Columbia, MD.

Program Element: #6.21.20.A
DoD Mission Area: #152 - Ordnance Technology

Title: Nuclear Weapons Effects, Fluidics
Budget Activity: #1 - Technology Base

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: A comprehensive electromagnetic pulse (EMP) program was initiated under which survivability levels have been established for all Army single and multi-channel radios, repeaters, and telephone terminals. Product improvement proposals to incorporate increased levels of EMP survivability into hardware have been initiated. Blast survivability levels for several helicopters, and the LANCE and PERSHING missile systems and various other equipment have been identified and many improvements made. A cost-effective radiation hardening program was begun. Radiation protection factors for M5 and other tanks were developed. An EMP calculational capability for near surface bursts was completed and immediately made available to the material development community. Technology was developed permitting nuclear hardening of electronic shelter designs. Antenna survivability product improvements were identified. Support was provided to Project Managers of many major systems in development such as the XM1 tank, the PATRIOT Air Defense System, and the COPPERHEAD anti-tank missile. Force survivability analysis began in FY 1977 and a field test was successfully conducted. Simulation facilities for Army and Tri-Service use were maintained. The first large area combined thermal and blast synergistic test was performed. Fluidics design and process data were obtained for injection molding of fluidic explosive initiators, temperature sensors and vortex rate sensors. Nuclear weapons effects on fluidics, effects of contamination of fluids, fluidically controlled dampers, and electrical to fluidic interface devices were examined and developed. Feasibility of a tank turret stabilization control system was demonstrated. Joint service turbine engine fuel control systems were passed to the Navy and Air Force for product improvement application to small auxiliary power system turbines. Fluidic power supplies for the General Support Rocket Systems (GSRS) were passed to the project manager for system integration.

2. FY 1978 Program: Electromagnetic pulse prototype fixes for multichannel and single channel communications systems will be developed and transferred to the appropriate project managers. Final refinement of electronic shelter design will be completed. Nuclear hardening techniques for emerging electronic and optical technology will be developed. Simulator operation and improvement efforts continue. Low altitude Electromagnetic Pulse (EMP) environmental definition and the associated computer programs will continue and will be made available to all appropriate project managers. Effort in area of maintaining nuclear hardness during production and after the fielding of systems will be expanded. All effort is directly related to the Army Nuclear Survivability Program. For fluidics, critical components for diesel engine fuel controls and suspension systems will be developed. A low cost servo valve will be evaluated and environmentally tested. Evaluation of fluidic actuators for missile flight controls will be completed.

3. FY 1979 Planned Program: Nearly all the nuclear survivability technology programs to harden appropriately critical command, control, and communications equipment on the tactical battlefield will be completed. Low altitude EMP and non-ideal blast environmental definition programs will continue. Hardening of the Army's tactical fire control system (TACFIRE) will be completed. Hardening for the Army's new family of radios (Single Channel Ground Airborne Radio Systems) will continue as

planned. Expansion of efforts will continue to manage nuclear survivability during production and offer fielding of systems. Low altitude electromagnetic pulse (EMP) hardware fixes for appropriate critical equipment will be developed. Efforts to calculate and measure the synergistic nature of nuclear effects on equipment will begin. The Tactical Operation System (TOS) will be hardened to high altitude EMP. The hardened shelter program will continue. Nuclear survivability efforts in support of emerging technology such as optical and laser components, fluidic devices, and micropower integrated circuits will continue. Engine test of fluidics fuel controls will be developed, a laboratory evaluation of backup turbine fuel controls will begin, feasibility on semi-active suspension systems will be demonstrated and a fuel mass flow meter for helicopters will begin development. The change in funding between FY 1978 and FY 1979 is dum to deferral of nuclear survivability tests until 1980.

4. FY 1980 Planned Program: The bulk of the electromagnetic pulse (EMP) hardening work on all appropriate tactical equipment will be completed. Hardness assessment of critical equipment to all nuclear effects will continue. Hardness assurance efforts will continue. The hardened shelter program will be completed. The fluidics fuel mass flow meter will be continued; fluidic control systems for laser controls will be designed and tested for feasibility. Self generating fluidic power supplies (hydraulic or pneumatic) at wheel axle will be fabricated and tested. Nuclear survivability tests will be initiated.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.22.01.A Title: Aircraft Weapons Technology
DoD Mission Area: #145 - Guns and Related Technology Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1613	1227	1910	1506	Continuing	Not Applicable
DH96	Aircraft Weapons Technology	1613	1227	1910	1506	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT: This program generates concepts and demonstrates the technical feasibility for application of advanced armament techniques and weapons to Army aircraft.

C. BASIS FOR FY 1979 RDTE REQUEST: Program efforts will result in the integration of a high performance gun with constant recoil and precision gun pointing/stabilization hardware into an advanced breadboard system for aerial demonstration. The millimeter wave radar research to develop signal processing techniques for air-to-ground for hidden targets and air-to-air for enemy aircraft will be completed and hardware fabrication for a feasibility demonstration will begin. Fire control work in support of HIGAD (High Impulse Gun Airborne Demonstration) will update computer software and hardware components. An automatic target cueing system will be fabricated and flight tested.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to determine the feasibility of applying advanced armament techniques and weapons to Army aircraft. Through investigations, analytical studies and laboratory tests data are acquired to determine the feasibility of improved aerial weapons systems. The program has four technical areas structured to achieve the foregoing objectives. The technical areas are: gun and mount, fire control, aerial munitions, and aerial rockets.

F. RELATED ACTIVITIES: Close liaison is maintained with the other military services and industry to avoid duplication of effort. The Army participates in the Tri-Service Joint Technical Coordinating Group for Air Launched Non-Nuclear Ordnance, an organization chartered at the major field command level. This group provides a medium for exchange of technical information and determination of joint use implications. An Army representative serves on the Air Munitions Requirements and Development Committee, an organization within the Office of the Secretary of Defense. One of the functions of this committee is the establishment of joint service requirements and development of air munitions. Related Advanced Development work is conducted under Program Element 6.32.06.A, Aircraft Weapons; and Engineering Development is under Program Element 6.42.02.A, Aircraft Weapons.

G. WORK PERFORMED BY: Aviation Research and Development Command (AVRADCOM), St. Louis, MO; Armament Research and Development Command (ARRADCOM), Dover, NJ; US Army Missile Research and Development Command (MIRADCOM), Huntsville, AL; US Army Materiel Systems Analysis Agency (AMSAA), Aberdeen, MD. Contractors: General Electric, Binghampton, NY; Westinghouse, Baltimore, MD; Firestone, Akron, OH; Aerojet General, Downey, CA; Boeing Aerospace, Seattle, WA; and Texas A&M University, College Station, TX.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Evaluation of competitive hybrid constant recoil concepts were performed. Technical determination was made to integrate advanced gun componentry to demonstrate advanced technology. High Impulse Gun Airborne Demonstration (HIGAD) project was initiated. Signal processing schemes were formulated to allow acquisition and tracking of fixed ground targets in clutter environment for millimeter radar. Optical sight model validation was performed which establishes a basis for comparison of advanced target acquisition methods with known optical performance. Helicopter air-to-air analysis was performed. A comparative cost effectiveness study of heliborne TOW and SHILLELAGH anti-armor missile systems was completed with the TOW selected as the most cost effective. Four contenders for a second generation area weapon were evaluated and the 30mm automatic gun was selected. A synthesis and cost comparison of potential third generation antitank guided missiles were completed. An evaluation was made of the cost of fire control effectiveness as a function of complexity and sophistication. Studies were conducted to determine aerial weapon systems reaction forces and blast effects on helicopters. Simulation models were developed to evaluate gun-type weapons with respect to weight, rate of fire, cost, accuracy and reliability. Additionally, concepts for a helicopter launched anti-radiation missile were evaluated. Fire control parameter analyses related to extending the range capabilities of ballistic and rocket weapons, remote control (drone) delivery systems, and night/all weather systems were conducted. Two firing tests, using the AH-1G helicopter, one turret and one wing mounted gun; were conducted to derive a control law by identifying the different components contributing to the total firing error and magnitude of each error source. The spin insensitivity and penetration potential of a shallow cone shaped charge were also demonstrated. A 70% reduction in projectile base drag by using fumers was demonstrated. Initial firing demonstrations using 2.75 inch rockets indicated that placement of submunitions in the target area are insensitive to variations in rocket trajectory, but do require an appropriate drag device to be incorporated into each submunition. Advanced ammunition concepts in telescoped configuration were investigated for optimization.

2. FY 1978 Program: An advanced gun system component integration effort was initiated to demonstrate the feasibility of integrating the advancements in constant recoil, high performance gun, closed loop fire control, and associated stabilization. Advanced gun design efforts will address the advantages and disadvantages among three competing gun designs utilizing telescoped, folded and separate loading concepts. Milimeter wave radar effort continues and will evaluate its application to Army helicopters for air-to-ground and air-to-air roles. Advanced boresight techniques investigation continues. Optimal filtering and on-board trajectory solution work will address improving the use of sensor states to effect target states to enhance future position prediction through the appropriate algorithms. Automatic target cueing continues by placing artificial intelligence in the processor to get increased versatility under varying target background conditions for television and FLIR (Forward Looking Infrared). Efforts will be directed toward providing ammunition test quantities for the High Impulse Gun Airborne Demonstration

gun demonstration to insure that adequate performance characteristics are achieved. The mass focus fragmentation will address the design of the fuse/wave shaper package and secondary trajectory stabilization for submunitions. Development of a low cost terminal trajectory correction capability for the 2.75 rocket also continues. The investigation to evaluate feasibility of using armed remotely piloted vehicles (RPV's) for extended range point target capability will be completed.

3. FY 1979 Planned Program: Fabrication of HIGAD (High Impulse Gun Airborne Demonstration) will be completed. The Laboratory testing of the HIGAD system will be initiated and the system will be installed on an AH-1G airframe. Validation of the optimally controlled turret model with torque disturbance inputs will be performed in support of the HIGAD program. A prototype auto target cueing system will be fabricated and flight tested. This will provide a target detection capability for use with remote view imaging sensors. This effort will establish the basis for the fabrication of a fully operational airborne auto target cueing system. Testing of the millimeter wave fire control for air-to-air/air-to-ground techniques will be completed and fabrication of hardware for a feasibility demonstration will begin. The HIGAD GUN testing effort will result in the need for refinements in ammunition design for higher performance; thus, initial work on smooth bore concepts for the HIGAD GUN, capable of defeating enemy armor, will begin. The mass focus fragmentation design effort will be tested after integration of the submunition with the rocket motor is completed. The terminal trajectory correction design effort will complete a design package that can be integrated as a modification to a 2.75 rocket. A precision point fire weapon concept will be pursued relative to using armed RPV vehicles to providing long-range standoff capability against enemy armor and hostile aircraft. Funding increase is reflected due to hardware requirements for the Millimeter Wave Radar Fire Control and HIGAD gun feasibility demonstrations.

4. FY 1980 Planned Program: Field demonstration of the HIGAD System on an attack helicopter will be completed and follow-on testing initiated if necessary. An anti-armor gun design, which is the next step in the evolution of helicopter gun design, will be addressed to identify the engineering characteristics and improvement that can be realized in comparison to a HIGAD Design. A long-range fire control designed so be compatible with long-range weapons will begin. Benefits gained from mast-mounted sensors, millimeter radar, optimal filtering techniques, FLIR (Forward Looking Infrared) and television techniques will be utilized to establish the basis for a long-range standoff fire control design which can be properly integrated with the concepts for attack helicopter weaponization. Continued effort in auto cueing will yield the data reduction necessary for analysis to establish system effectiveness for optimal filtering techniques. Tactical projectile feasibility investigation will address the development of lightweight steel cartridge case with emphasis on breadboard hardware and ballistic testing with the objective to provide a final engineering package. The mass focus fragmentation munition development will advance to final design stages to allow live firing tests to be performed during FY 80. The terminal trajectory correction design effort will progress to the design of the correction control items and complete development of the design for signal processing to provide the needed correction signals. A follow-on effort relating to use of armed RPV's will be planned in the event the present feasibility effort is successful.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.22.02.A
DoD Mission Area: #125 - Command and Control

Title: Aircraft Avionics Technology
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4362	5850	5768	5769	Continuing	Not Applicable
AH85	Aircraft Avionics Technology	4362	5850	5768	5769	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides the exploratory development technology base for Army avionics and air traffic control. The areas of investigation include communications, environment sensing, navigation, air traffic management, landing systems, cockpit instrumentation, digital/modular avionics and advanced avionics systems analysis. These efforts are focused on hardware which will enable around-the-clock aviation operations in a mid-intensity warfare environment.

C. BASIS FOR FY 1979 RDTE REQUEST: The FY 1979 request is based on the need to seek new solutions to significant tactical problems. Laser Obstacle/Terrain Avoidance Warning System (LOTAWS) efforts will provide insight into laser based alternatives for nap-of-the-earth (NOE) sensor systems. Under the Digital Modular Avionics Program (DIMAP) a flexible systems integration and simulation facility will become operational. With this facility future avionics systems can be configured and assessed prior to the preparation of firm specifications. Flight tests of a Global Positioning System (GPS)/Doppler hybrid navigation system will be conducted using available satellite coverage.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This exploratory development program explores new ideas, concepts and techniques in aviation electronics. The objective of the program element is to determine the feasibility of applying new aviation electronics technology to Army aircraft and related ground equipment. Particular emphasis is placed on helicopter operation at night, in adverse weather and at low level/nap-of-the-earth (NOE) altitudes.

F. RELATED ACTIVITIES: Related programs of the other Services, the National Aeronautics and Space Administration, the Federal Aviation Administration and other organizations are followed with committees, working groups, and joint developments to take advantage of techniques that can be applied to Army problems. Resources are concentrated on problems which are Army unique or not addressed by other development activities. This program element leads to developments in Program Elements 6.32.07.A (Aircraft Avionics Equipment) and 6.42.01.A (Aircraft Avionics).

G. WORK PERFORMED BY: US Army Avionics Research and Development Activity, Fort Monmouth, NJ. Contractors include: Marchand Electronics, Incorporated, Greenwich, CT; Bendix Corporation, Baltimore, MD; United Technology Research Center, E. Hartford, CT; ALL Cutler-Hammer, Farmingdale, NY; Honeywell, Incorporated, Avionics Division, St. Louis Park, MN; Fairchild Camera and Institute Corporation, Syosset, NY; Hughes Aircraft Company, Culver City, CA; Litton Systems, Incorporated, Van Nuys, CA; American Electronics Laboratory Incorporated, Wall Township, NJ; Litchford Electronics, Incorporated, Northport, NY; and Grumman Aerospace Corporation, Bethpage, NY.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Successfully bench/flight tested hover sensor applique. Successfully bench tested breadboard components of electronic counter-countermeasures (ECCM) adaptive antenna applique. Ground and flight tested optimum location and radiation patterns of new high frequency loop antenna derived from computer modeling. Conducted flight tests of improved AN/ASN-43 heading reference unit which resulted in a product improvement program on the AN/ASN-43. Developed a standard flight test plan to evaluate state-of-the-art attitude and heading reference systems. Constructed computer model of Global Positioning System/Doppler hybrid navigation system. Demonstrated concept of Very Lightweight Air Traffic Management Equipment (VLATME) using miniaturized L-Band interrogators for air traffic control. Successfully completed concept evaluation program designed to assess ability to land helicopters with steep decelerated profiles into confined tactical sites. Completed conceptual design study for crossbanded microwave landing system/transponder system. Completed Army/Air Force microwave landing system polarization tests. Initiated tests of manpack size Ku-band landing system. Initiated development of Lightweight Multifunction Tactical Beacon System (LMTBS) which is designed to provide navigation/position fixing, approach and landing, hazard warning, formation flying, collision prevention and station keeping. Redesigned Terrain Trend Sensor (TTS) to incorporate lighter weight, smaller components with greater reliability. Demonstrated feasibility of Wire Obstacle Warning System (WOWS) using charge coupled devices. Demonstrated multifunction Laser Obstacle/Terrain Avoidance Warning System (LOTAWS) scanning laser system. LOTAWS has detected 1/8 inch wires at a range of 1500 feet, and power lines out to one mile. Flight tested nap-of-the-earth (NOE) pilotage system. Designed, fabricated and programed Microprocessor Interface Unit (MIU) for use in flight tests of integrated target acquisition and navigation systems. Completed conceptual system design/and integrated Digital Modular Avionics Program (DIMAP) bench facility with Tactical Avionics System Simulator (TASS) using MIL-STD-1553A data bus.

2. FY 1978 Program: Perform comparative test/evaluation of automatic steerable null antenna processor and adaptive antenna applique for airborne tacticals radios. Evaluate Control Display Unit (CDU) Models. Prepare specifications and procurement package for AD models of Radio Magnetic Indicator/Horizontal Situation Indicator (RMI/HSI). Analyze dead reckoning navigation system accuracy as function of updating. Conduct flight tests of conventional gimbaled and strapdown Attitude Heading Reference System (AHRS). Complete evaluation of feasibility models of Very Lightweight Air Traffic Management Equipment (VLATME). Complete evaluation of Beacon Collision Avoidance System (BCAS) experiment and initiate feasibility model of VLATME/BCAS which derives air traffic control information in active and passive modes. Complete evaluation of lightweight E-SCAN antenna and

investigate adaptation of E-SCAN antenna to Very Lightweight Air Traffic Management Equipment/Beacon Collision Avoidance System (VLATME/BCAS) system. Investigate potential application Integrated Communications-Navigation-Identification techniques to Army air traffic control. Complete evaluation of Ku-band manpack landing system. Complete computer simulation of high density helicopter landing operations (controller/pilot coordination). Initiate joint Army/National Aeronautics and Space Administration (NASA) definition and simulation of advanced integrated display formats for helicopter steep approach and landing. Investigate top level system architecture for entire aircraft electronic system. Complete design and fabrication of Wire Obstacle Warning System (WOWS). Evaluate capability of multifunction Laser Obstacle/Terrain Avoidance/Warning System (LOTAWS) to detect wires close to background and to function as a rangefinder. Continue nap-of-the-earth (NOE) navigation task with emphasis on providing necessary information to maneuver and navigate at low levels at night.

3. FY 1979 Planned Program: Use simulation facility to interact with digital helicopter flight validation of the night navigation/pilotage system. Complete first top level system architecture formulation for total avionics system. Continue effort on digital helicopter system, under Digital Modular Avionics Program (DIMAP), to obtain flexible system integration tool with which future avionics systems can be assessed. Start study and design of master monitor/advisory display. Start study of standardization of navigation control and display functions based on FY 1978 results. Integrate and test Global Positioning System (GPS)/Doppler hybrid navigation system. Continue development of VLATME/BCAS/E-SCAN feasibility models. Investigate potential applications, analyze candidate concepts and establish best approach for exploiting leading Integrated Communications, Navigation and Identification/Time Division Multiple Access (ICNI/TDMA) systems for air traffic control. Formulate design specification for integrated steep approach landing display based on results of joint Army/NASA simulation program. Assess state-of-the-art technology for self-contained landing system. Flight test Lightweight Multifunction Tactical Beacon System (LMTBS). Fabricate and test Wire Obstacle Warning Systems (WOWS). Fabricate LOTAWS/Multifunction LOTAWS hardware.

4. FY 1980 Planned Program: Integrate night navigation pilotage system with high accuracy self-contained terrain correlation navigation system. Test the master monitor/advisory display. Prepare specification for cockpit control and display integrated design. Initiate testing of ring laser gyro Attitude Heading Reference System (AHRS). Continue flight tests of Global Positioning System (GPS)/Doppler hybrid using satellites. Complete development of feasibility model of Very Lightweight Air Traffic Management Equipment (VLATME)/Beacon Collision Avoidance System (BCAS)/E-SCAN and initiate tests of applicability of BCAS techniques to Army air traffic control. Initiate effort to overcome technical barriers in the development of self-contained landing system. Initiate landing system flight test program to investigate problems associated with adverse weather, helicopter, decelerated steep approach and landing operations.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.22.09.A Title: Aeronautical Technology
DoD Mission Area: #142 - Aeronautical Vehicle Technology Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	15877	15344	15659	17371	Continuing	Not Applicable
AH76-01	Aerodynamics	2288	1840	2408	2441	Continuing	Not Applicable
AH76-02	Structures	2934	2955	3004	2828	Continuing	Not Applicable
AH76-03	Propulsion	2888	3034	2817	2924	Continuing	Not Applicable
AH76-04	Reliability & Maintainability	1826	1611	1533	1895	Continuing	Not Applicable
AH76-05	Safety & Survivability	2047	1961	2434	3072	Continuing	Not Applicable
AH76-06	Mission Support	691	679	920	1050	Continuing	Not Applicable
AH76-07	Aircraft Systems Synthesis	1056	1143	1063	1059	Continuing	Not Applicable
AH76-08	Aircraft Subsystems	451	538	688	672	Continuing	Not Applicable
AH76-09	Remotely Piloted Vehicles	497	0	0	0	Continuing	Not Applicable
AH76-10	R&D Flight Simulator	1046	1398	299	830	Continuing	Not Applicable
AH76-11	Aviation Human Engineering	153	185	493	600	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides and develops the aeronautical technology base required for improvements in the operational effectiveness and mission capability of Army aviation systems. Technical areas included are: aerodynamics, structures, propulsion, reliability and maintainability, safety and survivability, mission support, aircraft systems synthesis, aircraft subsystems, remotely piloted vehicles, flight simulation, and man-machine integration.

C. BASIS FOR FY 1979 RDTE REQUEST: The FY 1979 program provides for the continuing development of the aeronautical technology base with particular emphasis directed toward filling technological voids or deficiencies in the areas of rotor flow field, dynamic stall, helicopter drag, rotor/fuselage interaction, ground proximity effects, dynamics of hingeless rotors, vibration reduction, stability, control, handling qualities, design criteria, advanced structures (composites) for rotors and airframe and small gas turbine engine components. Additional areas of effort include development of diagnostic-condition monitoring capability; reduction of visual, acoustic, radar and infrared signatures; development of high energy laser protection concepts; improved ballistic tolerance and crashworthiness; development of day/night terrain flying capability for tactical and cargo transport missions; development of adverse weather mission capability including helicopter ice protection and development of helicopter ground movement system; and R&D simulator capability.

D. OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.22.09.A Title: Aeronautical Technology
DoD Mission Area: #142 - Aeronautical Vehicle Technology Budget Activity: #1 - Technology Base

E. DETAILED BACKGROUND AND DESCRIPTION: The purpose of this program is to provide a sound technological base for advanced and engineering development programs by providing and developing the aeronautical technologies required for improvements in the operational effectiveness and mission capability of Army aviation systems. Areas of investigation within the technology disciplines consist of the following: fluid mechanics, dynamics, flight control, acoustics; design criteria, weight prediction, material engineering, internal/external loads, fatigue and fracture mechanics, structural concepts; small air flow gas turbines including aerothermodynamics and controls, engine accessories, thrust producers, high-temperature materials, mechanical drive systems; diagnostics and prognostics, maintenance and support; survivability through reduced detectability and aircraft and aircrew protection, flight safety; cargo handling systems, ground support equipments; secondary power systems, environmental control systems; flight simulations; and aviation human engineering. Developments in these technologies have applications to all Army aircraft systems of the future, including the Advanced Scout Helicopter, the Advanced Attack Helicopter, the UH-60A BLACK HAWK Helicopter, the CH-47 Medium Lift Helicopter, and other product improvement programs.

F. RELATED ACTIVITIES: Related programs are performed by the National Aeronautics and Space Administration (NASA), Navy, Air Force, and Department of Transportation. Coordination to eliminate unnecessary duplication is accomplished by: program reviews, exchange of program data sheets, research and technology resumes, technical reports; interservice liaison, attendance at scientific meetings and conferences; and joint participation in The Technical Cooperation Program, NASA Research and Technology Committees, and the North Atlantic Treaty Organization (NATO) Advisory Group on Aerospace Research and Development. This program is included in the Tri-Service Aeronautical Vehicle, Structures and Aircraft Propulsion Technology Coordinating Papers. Efforts under this program lead into Advanced Development under Program Elements 6.32.01.A, Aircraft Power Plants and Propulsion; 6.37.11.A, Aircraft Survivability/Electronic Warfare Self-Protection (EWSP); 6.32.09.A, Air Mobility Support; 6.32.11.A, Advanced Vertical Take-Off and Landing (VTOL); and 6.32.12.A, Tilt Rotor Research Aircraft, as well as aircraft systems development.

G. WORK PERFORMED BY: The in-house portion of this program is accomplished at the US Army Research and Technology Laboratories, Moffett Field, CA; through the Aeromechanics Laboratory, Moffett Field, CA; Applied Technology Laboratory, Fort Eustis, VA; Structures Laboratory, Langley Research Center, VA; and Propulsion Laboratory, Lewis Research Center, OH. Fifty-one percent, or approximately seven million dollars, of the budget for this program is contracted. The top five contractors are Boeing Vertol Company, Philadelphia, PA; Sikorsky Aircraft, Stratford, CT; Pratt and Whitney Aircraft, West Palm Beach, FL; Bell Helicopter Textron, Fort Worth, TX; AiResearch Manufacturing Company, Torrance, CA. At least twelve other contractors will share in this program. Many contracts are still open on a competitive basis.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: The autorotation maneuver program analysis was completed. A helicopter hub/pylon drag analysis and testing program was initiated. A circulation control tail boom mounted on an OH-6A helicopter and a high energy rotor on an OH-58 helicopter were tested. Full-scale whirl tower and flight tests of a UH-1 rotor with Ogee tips and flight tests of three advanced rotor blade profiles on an AH-1G were completed. Wind tunnel full-scale tests of a Sikorsky S-76 research rotor and a full-scale multicyclic controllable twist rotor were conducted. A generic helicopter simulation

math model was developed and two simulation experiments for terrain flying were conducted. Visual, motion and simulation systems requirements for the Aviation Research and Development Command R&D simulator were developed. An advanced engine inlet air particle scavenge system demonstrated five times the life of previous scavenge systems in an erosive sand and dust environment. This success led to the use of a similar system on one of the two 800 shaft horsepower advanced technology demonstrator engine designs. Several high-speed (20 thousand revolutions per minute, 1500 horsepower, overrunning (free wheeling) clutch designs for helicopter drive systems were developed and successfully rig tested. The best of these clutch designs provides the potential for significant weight and cost reduction on operational aircraft. Tactile display devices for reduction of pilot workload were developed and tested. Damaged rotor blade life estimation method was developed. Super-hard windscreen coatings and elastomeric bearing programs were developed. Fast repair techniques for metal rotor blades were demonstrated. Oil debris analysis program was improved. Developed technology for reducing radar signature of helicopter rotor blades.

2. FY 1978 Program: A hover performance analysis using lifting surface theory will be completed. A three-dimensional helicopter fuselage drag analysis will be extended. A program to define configuration aerodynamics for single rotor helicopters from scale model data will be completed. Results of Vee-tail wind tunnel tests will be analyzed to determine feasibility of the concept. A scale model of an advanced UH-1 helicopter rotor will be designed and fabricated and testing will be initiated. The range of applicability of a noise prediction program will be determined through data correlation. A ground-based simulator experiment for Nap-of-the-Earth flight will be accomplished to evaluate basic Stability and Control Augmentation System designs. Development of a Phase I visual system specification for the R&D simulator will be initiated and detailed design tradeoff studies of required motion system will be completed. A contract will be awarded to demonstrate the feasibility of incorporating a constant-speed, axial compressor booster stage within the inlet of the engine inlet air particle separator of turbine engines. A booster stage has the potential to replace the air particle separator scavenge blower system and to provide a significant increase in engine power. Two independent fabrication processes for economically manufacturing cooled, radial-flow turbines are being evaluated. CH-47 and UH-60A BLACK HAWK helicopters terrain flying concept analysis will be completed and external cargo operations technology assessments will be initiated. Design improvements leading to lightweight, low-cost mission effective gondola configurations will be initiated. Ground and flight testing to establish and validate hub face vibration simulation methods will be completed. An improved superhard coating will be tested on UH-1 helicopter windscreens. Investigation of improved fault isolation methods for helicopter maintenance and field evaluation of the improved oil analysis method will be initiated. Improved vibration analysis techniques and a method to alleviate mast bumping will be investigated. A helicopter structural integrity program, an analysis of bearingless main rotor stability, increased helicopter agility methods, and a study of second generation composite rotor concepts will be initiated. Man-machine integration R&D will continue development of improved aircrew workload and performance measurement, task analysis and modeling for tactical Army missions, validation of simulator design goals in visual display areas and refinement of helicopter tactile display devices. Improved crash survivability of aircraft structures, crew and passengers will be provided through structural design criteria and analytical techniques. Efforts on CH-47 crash tests will be completed. The design guide for infrared suppressions will be completed.

3. FY 1979 Planned Program: Programs to validate the lifting surface theory hover analysis, to improve loads analysis, and to improve rotorcraft wake analysis will be initiated. A study to identify methods and devices for improving autorotation and maneuver capability will be initiated. The hub/pylon drag tests will be completed. Wind tunnel studies of main rotor/tail

rotor flow interactions, rotor/fuselage/empennage optimization, and engine exhaust gas reingestion will be initiated. Design of the R&D simulator Phase I visual system and motion system will be initiated and simulation system studies will continue. Development of second generation comprehensive helicopter analysis system will be initiated. Fabrication and mechanical integrity testing of two cooled, radial-flow turbine designs and complete design, fabrication and testing of five diffuser designs for a 10:1 pressure ratio will be completed. External cargo operation technology will continue with initiation of wind tunnel tests of candidate systems. Efforts to obtain a satisfactory ice phobic coating for main rotor blades will continue with laboratory and flight testing of promising materials. Fabrication of dynamic test hardware for the microwave deicing concept will be initiated. Man-machine integration efforts will be continued in the areas of aircrew workload, flight simulation, information transfer and man-machine dynamics. Investigation of active rotor loads control and composite fuselage fabrication program will be initiated. Rotor dynamic testing, vibration reduction, reduced mast bumping device evaluation, aero-elastically conformable rotor systems study and structural integrity modernization will continue. Hub face vibration analysis studies will be completed. The capabilities of the Logic Model Test Set will be evaluated on AH-1 aircraft. The number of personnel involved will be 269. Minor increase in funding for FY 79 is to partially offset inflationary erosion of the technology base level of effort.

4. FY 1980 Planned Program: Hover analysis validation and wake analysis improvement will be completed. Loads analysis improvement will continue. The study of autorotation improvement methods and devices will continue. Wind tunnel tests of main rotor/tail rotor interactions and exhaust gas reingestion will be completed. A tail rotor loads investigation will be initiated. Noise analysis and design work will continue. Ground-based and in-flight nap-of-the-earth experiments will continue. Development of an improved handling qualities specification will be initiated. Phase I visual system designs for the R&D simulator will continue and Phase II preliminary design will be initiated. Motion system design will be completed and simulation system design will be initiated. Development of technology modules for the Comprehensive Analysis System will be initiated. Design, fabrication, and test of an optimized 10:1 pressure ratio centrifugal compressor will be completed. Design, fabrication, testing, and data analysis of a constant-speed, axial compressor, booster stage within the inlet air particle separator will be completed. A program to design, fabricate, and test a moderate pressure ratio, centrifugal compressor stage for efficient operation behind an existing one-or two-stage axial-flow compressor will be initiated. Concept verification testing for a ground movement system will be initiated. Fabrication of hardware for microwave deicing system will be completed and testing initiated. Logic Model Test Set and techniques will be applied to aircraft systems for field evaluation. Advanced structural concepts will be evaluated for maintenance and diagnostic improvements. Man-machine integration research and laboratory support will continue. Vulnerability investigations will continue.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.22.10.A
Title: Airdrop Technology
DoD Mission Area: #154 - Mobility and Logistics Technology
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	760	1155	1208	1888	Continuing	Not Applicable
D283	Airdrop Technology	760	1155	1208	1888	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports basic airdrop technology, evaluates the feasibility and practicability of new concepts which have potential for increasing the mission capabilities of airdrop operations and/or the potential for reducing the costs in acquisition, use, and maintenance of, airdrop systems and equipment. The airdrop research, development, test and evaluation (RDTE) program, which supports all of the Services, is important for the employment and resupply of airborne forces as well as the resupply of conventional units. Airdrop projects are included in the critical category priority list and the Science and Technology Guide (STOG), Capabilities Categories (CAPCAT) 78-5.

C. BASIS FOR FY 1979 RDTE REQUEST: Continue exploratory work in the areas of Gliding Decelerator Technology, High Level Airdrop Technology, and Advanced Airdrop Technology. Initiate work in the areas of High Speed Airdrop Technology, Airdrop Simulation, and Free-Drop Technology.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Major areas of effort are: the validation of computer modeling of high glide decelerators; define and test feasible and practical airdrop guidance and control systems; exploration of airdrop capability at higher aircraft drop speeds and airdrop altitudes; and continuation of advanced airdrop technology efforts. Objectives are to increase airdrop operational capabilities at all altitudes and in all weather and geographical environments, increase aircraft drop speed and accuracy, reduce drop zone dispersion, provide the technology base for advanced airdrop systems, and eliminate technical barriers hindering attainment of new airdrop capabilities. Systems should assist in reducing airlift aircraft vulnerability to enemy air defense threats.

F. RELATED ACTIVITIES: Advanced development (AD) Program Element (PE) 6.32.09.A, Engineering Development; PE 6.42.04.A, Joint Technical Coordinating Group/Airdrop; North Atlantic Treaty Organization, and Air Standardization Coordinating Committee (ASCC/

WP44) Standardization Agreements (STANAGs); Mutual Weapons Data Development Exchange Agreements with France and Germany. International and inter-Service agreements and boards are utilized to exchange information on gains in research technology and avoid duplication of effort through joint and combined efforts.

G. WORK PERFORMED BY: Raytheon Corp., Boston, MA; Magnavox Corp., Fort Wayne, IN; Cubic Corp., San Diego, CA; Polhemus Navigation Sciences, Inc., Burlington, VT; Pioneer, Manchester, CT; Paraflite, Inc., NJ; Irving of Canada, Canada; US Army Natick Research and Development Command (NARADCOM), Natick, MA.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: A computer simulation program for the flight performance of gliding decelerators was completed; work was initiated to validate computer model through flight testing. Defined gliding decelerator guidance and control prototype equipment. Developed simplified rigging concepts for use of energy dissipater materials. Awarded contract to study platform pitch instability of airdrop at high altitudes. Initiated study to identify operationally feasible concepts for airdrop ground assembly aids. Established design concepts for parachutist's jump pack for DRAGON weapon missile. Completed investigation to select canopy design concept for free-fall steerable reserve parachute and procured test quantities. Work initiated to identify and test new materials for three-gallon free-drop water container. Participated in airdrop tests from Air Force Advanced Medium STOL Transport (AMST) Aircraft (YC-14, YC-15) and YC-141B aircraft; prepared Army airdrop evaluation reports.

2. FY 1978 Program: Complete validation of gliding decelerator computer modeling through actual flight tests. Define through computer simulation high potential guidance and control system(s). Evaluate medium capacity gliding decelerator for flight performance. Continue studies on rigging concepts for integrating parachutist with accompanying equipment and weapons. Initiate flight testing of High Level Platform Airdrop System for pitch stability. Study and initiate feasibility testing of potential airdrop ground assembly aids. Initiate a program definition study for developing techniques, equipment and facilities for laboratory simulation of the airdrop environment. Continue airdrop engineering and technical support to the development and test of Air Force aircraft (YC-14, YC-15, YC-141). Complete testing of new materials for three-gallon free-drop water container. Conduct feasibility tests of prototype free-fall reserve parachute.

3. FY 1979 Planned Program: Procure prototype guidance and control subsystem for medium capacity gliding decelerator and initiate testing. Initiate design and fabrication of high capacity gliding decelerator. Complete flight testing of prototype components to solve pitch instability problem of High Level Airdrop Platform System. Initiate studies on airdrop at high aircraft release speeds. In accordance with plans developed in FY 1978, initiate efforts to develop laboratory simulation techniques and equipment for airdrop parameters. Complete evaluation of airdrop ground assembly aids concepts. Resume study efforts to develop technology base for the design of free-drop resupply airdrop systems.

Program Element: #6.22.10.A Title: Airdrop Technology
DoD Mission Area: #154 - Mobility and Logistics Budget Activity: #1 - Technology Base

4. FY 1980 Planned Program: Complete testing of gliding decelerator with alternative guidance and control systems; conduct airdrop flight tests of high capacity gliding decelerator; document results of feasibility studies to date and select airdrop gliding decelerator systems for advanced development under Program Element 6.32.09.A, Airdrop Prototypes and Techniques, Project D279. Complete feasibility work on High Level Platform Airdrop System. Continue exploration of new airdrop concepts, studies on airdrop at high aircraft speeds, and development of laboratory simulations and equipment for airdrop. Continue efforts to provide data base for design of free-drop resupply airdrop systems.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.23.03.A Title: Missile Technology
DoD Mission Area: #144 - Guided Missiles and Rockets Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	27744	26276	30126	27949	Continuing	Not Applicable
A214-01	Sensors Technology	4295	4445	5459	5323	Continuing	Not Applicable
A214-02	Guidance and Control Technology	4667	3990	4275	3875	Continuing	Not Applicable
A214-03	Terminal Guidance Technology	4008	3325	4146	3539	Continuing	Not Applicable
A214-04	Propulsion Technology	2529	2232	2825	2575	Continuing	Not Applicable
A214-05	Aerodynamics Technology	2604	2527	2841	2690	Continuing	Not Applicable
A214-06	Ground Support Equipment Technology	535	976	1000	938	Continuing	Not Applicable
A214-07	Nuclear Weapons Effects Technology	172	60	0	0	Continuing	Not Applicable
A214-08	Structures Technology	672	1000	1190	1128	Continuing	Not Applicable
A214-09	Experimental Systems Technology	3105	2214	1768	1700	Continuing	Not Applicable
A214-10	Systems Concepts and Analysis Technology	591	300	330	330	Continuing	Not Applicable
A214-11	Hybrid Microelectronics Technology	400	287	330	275	Continuing	Not Applicable
A214-12	Simulation Research Technology	2416	2352	3130	2895	Continuing	Not Applicable
A214-13	Free Flight Rocket Technology	1337	1263	1419	1321	Continuing	Not Applicable
A214-14	Digital Technology	150	555	550	550	Continuing	Not Applicable
A214-15	Sensors and Control for Guided Projectiles	0	300	355	330	Continuing	Not Applicable
A214-16	High Energy Laser Research	0	450	508	480	Continuing	Not Applicable
A214-17	Laser Technology	163	0	0	0	Continuing	Not Applicable

Program Element: #6.23.03.A Title: Missile Technology
DoD Mission Area: #144 - Guided Missiles and Rockets Budget Activity: #1 - Technology Base

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program includes virtually all exploratory development work conducted by the US Army Missile Research and Development Command to provide the technological base for future Army tactical missiles and improvements to current systems. The work includes applied research, laboratory hardware and component development, and limited full scale experimental testing.

C. BASIS FOR FY 1979 RDTE REQUEST: Continue exploratory development of missile related technology applicable to future missile systems and improvements to current systems. As a one-time requirement only, a high power test program for the Hemispheric Coverage Antenna (HCA) is being funded under this program element. This $1.8 million effort is referred to as the Hemispheric Radar Test Bed (HRTB) and is funded entirely under the Sensors Technology Area.

D. OTHER APPROPRIATION FUNDS: None.

E. DETAILED BACKGROUND AND DESCRIPTION: This program provides Army research in missile and rocket technology and supports improvements to currently deployed systems and development of future systems. It encompasses all of the direct support of exploratory development work conducted by the US Army Missile Research and Development Command to provide the technological base for future and current Army tactical missile systems. The work is divided into 17 technology areas (corresponding to the Project Numbers listed in paragraph A) including sensors, guidance and control, terminal guidance, propulsion, aerodynamics, ground support equipment, nuclear weapons effects, structures, experimental systems, systems concepts and analysis, hybrid microelectronics, simulation research, free flight rockets digital technology, sensors and control for guided projectiles, and lasers. The work includes development, breadboard hardware fabrication, feasibility demonstrations and limited full scale experimental testing.

F. RELATED ACTIVITIES: These efforts are closely related to work in the same technology areas being conducted by the Defense Advanced Research Projects Agency, the US Air Force, the US Navy, the National Aeronautics and Space Administration (NASA), and by other activities within the Army. Coordination is effected through interagency groups, frequent liaison visits, independent research and development, and information exchanged through the Defense Documentation Center and the National Technical Information Service. Unproductive effort and duplication is precluded by this information flow and by concentrating on specific areas particularly critical to Army tactical missile requirements. Active membership exists in working groups of the Joint Technical Coordinating Group, Joint Service Guidance and Control Committee, the Technical Coordinating Panel, and Joint Army/Navy/NASA/Air Force (JANNAF) and North Atlantic Treaty Organization Panels.

G. WORK PERFORMED BY: US Army Missile Research and Development Command, Huntsville, AL; Texas Instruments, Inc., Dallas, TX; General Electric Company, Huntsville, AL; Hughes Aircraft Corporation, Fullerton, CA; Thiokol Chemical Corporation, Huntsville, AL; US Army Aviation Research and Development Command, St. Louis, MO; US Army Armament Research and Development Command, Dover, NJ; Martin-Marietta Corporation, Orlando, FL; and approximately 50 additional contractors and universities.

Program Element: #6.23.03.A Title: Missile Technology
DoD Mission Area: #144 - Guided Missiles and Rockets Budget Activity: #1 - Technology Base

B. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Sensors - defined critical requirements of controlled signature radar and completed antenna conceptual designs; completed survey of acoustic technology for weapon applications; demonstrated Gallium Arsenide (GaAs) and Carbon Dioxide (CO_2) beamrider guidance links; conducted field tests with available millimeter guidance hardware; completed exploratory development of an infrared (IR) imaging seeker; finalized indirect fire infrared land combat modeling approach; completed initial testing on common aperature multispectrum radio frequency (RF) seeker; completed breadboard fabrication of multienvironment active RF seeker; designed and tested microprocessor/tracker and associated algorithms; fabricated seeker and tested side-by-side with seeker. Guidance and Control - updated all simulations and initiated hardware in-the-loop testing on contractor digital autopilot hardware; completed initial development phase on a high performance, low cost accelerometer; designed and tested an inertial measuring unit (IMU); analyzed and prepared technical requirements for an internal bearing stabilized sight unit; completed laser designator/weapon system simulation Phase 1. Terminal Guidance - completed laboratory and captive flight tests on a laser/infrared dual mode seeker; fabricated an imaging seeker employing a focal plane array and sophisticated tracking algorithms functioning under control of a microprocessor; demonstrated in field tests the inherent advantages of longer wavelength infrared laser systems to penetrate a variety of tactical smokes; investigated various longer wavelength infrared laser sources and sensors for application to long wavelength beamrider guidance; conducted joint smoke measurement experiments with Armor Board and other agencies including US Army Training and Doctrine Command, US Army Material Systems Analysis Agency, US Army Electronics Command and Edgewood Arsenal. Began infrared measurements to provide simultaneous micrometer radiance maps of targets in backgrounds; initiated design of a recoverable airframe for test of indirect fire land combat seekers. Propulsion - began establishment of propellant characteristics/wavelength/atmospheric condition relationships experimentally and analytically, and correlation obtained with flight data; completed demonstration of a minimum smoke motor for the HELLFIRE Heliborne Antiarmor System; initiated laser beamrider propulsion investigations; formulated lower cost propellant with HDX replacing HMX (RDX and HMX are code names for complex chemicals); fabricated and tested low cost component concepts; defined statistical thermal loads and developed gassing cumulative damage analysis; developed Hydroxyl Terminated Polybutadiene (HTPB) propellant for PERSHING; utilized polymer technology in solving the improved HAWK motor onboard Air Defense Missile problem and the STINGER Air Defense Missile high temperature aging problem. Aerodynamics - developed transonic drag calculation for electro-optical/infrared missile configurations; established helicopter downwash data base for air launch missile simulation; determined flight conditions for which plume induced interference occurs for the General Support Rocket System (GSRS); established viscous scaling effects for maneuvering missile aerodynamics; completed an engine/plume model for improved signature definition of threat aircraft; demonstrated fiber optics guidance package operation in rocket flight tests; established feasibility of a small hypervelocity armor penetrator system (SPIKE). Ground Support Equipment Technology - fabricated an elevating vibration isolator for helicopters and completed acceptance vibration testing; developed mathematical model for selecting combinations of cushioning materials for missile containers; completed design of a low cost basic launcher and

ped and began fabrication of components; established calibration techniques for magnetic detection of mallaunch rates. Nuclear Weapons Effects - completed the baseline design of an E-Field Cable Driver; performed susceptibility analysis of E-Beam controlled high energy lasers to ionizing radiation; determined the effects of nuclear radiation on high burn rate propellants; simulated blast-induced ablation from the surfaces of missile-like structures; obtained specific data on effects of nuclear radiation on missile electro-optical components. Structures - included geometric nonlinearities in composite structures analysis computer codes; developed and tested large filament wound launch tubes and motor cases; identified through rain and thermal erosion testing improved structures (plastics) for radomes for PERSHING II and PATRIOT; collected and analyzed experimental data on fracture characteristics in plane stress; published first volume of fracture mechanics design handbook; constructed a real time acoustical holography system for structural analysis operation; initiated identification of structural scaling principals and reviewed existing and proposed techniques; investigated composite structures use in aircraft and automotive industry for applications to missiles. Experimental Systems - demonstrated foreign-designed follow-through liners in light antitank weapon warheads for military operations in built-up areas (MOBA); fabricated and assembled passive radio frequency (RF) hardware; completed active RF seeker design and fabrication; demonstrated usefulness of distance measuring equipment (DME) techniques for guiding a missile. Systems Concepts and Analysis - correlated laboratory plans and system concepts with Science and Technology Objectives Guide (STOG)-78; supported foreign technology assessments; developed smoke and aerosol model and evaluated sensor performance. Hybrid Microelectronics - completed fabrication and environmental qualification of a digital autopilot; developed precise thermal characterization model for high density hybrids; developed a method for printing circuits directly on metallic substrates; developed techniques and procedures for printing thick film fine lines. Simulation Research - initiated development of an advanced hybrid operating system; completed first phase of development for a distributed radio frequency (RF) clutter/target modeling concept and established hardware performance requirements (this capability supports several DoD active semiactive and command guided RF seeker development programs); demonstrated RF jammer simulation capability; upgraded capability of long-wave infrared target/background simulation. Free Flight Rocket Technology - completed series of 10 thousand pounds and 17 thousand pounds thrust firings using three types of spin devices; determined criteria for cold gas simulation; demonstrated low cost foam launcher; designed, loaded and fired accuracy demonstration motor with optimized grain design/propellant; designed recoverable instrumentation and catcher assembly. Digital Technology - developed macro instruction set for microprogrammed guidance and control computer; established FORTRAN subset for guidance and control applications; analyzed higher order languages for interim candidate for tactical computer application, including life cycle considerations; supported continued development of digital test bed. Sensors and Control for Guided Projectiles (New Technology Area to support needs of projectile community) - initiated development of a high volumetric efficiency gas generator for actuating controls; began development of a noninertial roll rate reference system, capable of surviving in a high-g environment; began development of high-g hardened components for air defense suppression projectiles. Laser Technology - reduced by a factor of four, the optical wavefront distortion caused by the light sensitive cadmium sulfide film stress; performed laboratory experiments to determine and compare the performance of two liquid crystal modulators; evaluted the composite or multiplex technique for applicating to training aids; made and demonstrated holograms of a tank model at Headquarters, US Army Training and Doctrine Command.

2. FY 1978 Program: Sensors - establish design for a low sidelobe, agile radar beam; perform final test of an infrared (IR) detection and acquisition advanced signal processor; refine acoustic signature base and define applications; investigate alternate spectral regions for command and beamrider use; design antennas; define non-imaging infrared seeker test for IR and low cost IR sensors and initiate advanced signal processing via microprocessors; test breadboard active RF seeker; complete common aperture multispectrum seeker (CAMS) captive tests and develop multienvironment active radio frequency seeker simulation model. Guidance and Control - complete hybrid microelectronic fabrication, hardware testing, hardware-in-the-loop simulation, and select autopilot designs for flight testing of digital autopilot. Develop a quartz flexure accelerometer with improved bias and scale factor stability; develop, validate and verify navigation, guidance and autopilot software. Evaluate inertial measuring unit (IMU) and control actuator system in hardware-in-the-loop simulation; conduct sled tests on the IMU to verify accuracy and validate error model; design, fabricate and test missile, test equipment, and Ground Support Equipment for the simplified inertial guidance demonstration (DIG-D); evaluate and integrate internal bearing stabilized sight unit into helicopter; design and fabricate a digital automatic handoff system; perform experiments on automatic techniques for eliminating boresight errors; and investigate techniques to enhance target-to-background contrast for target designation systems. Terminal Guidance - expand existing laser designator/weapon system simulation program to accommodate imaging and nonimaging seekers; conduct laboratory and field tests of microprocessor controlled, low light level intensified charged coupled device seeker with adaptive gate, correlation, and moving target tracker algorithms; complete assessment of longer wavelength infrared semi-active laser guidance capabilities; conduct target measurements in terrain background - laser, infrared, radio frequency/millimeter. Propulsion - demonstrate a beamrider motor with a high performance, low cost (HMX replaced by RDX), cross-linked, case bondable, double base propellant; demonstrate an epoxy cured smokeless multi-wired cross-linked, double based propellant with smokeless inhibitor/boot and insulation; continue experimental and analytical efforts to develop propellants and establish relationships with wavelength and atmospheric conditions; extend service life predictive techniques; improve reproducibility of high burning rate propellant manufacturing process for ultra-fine ammonium perchlorate process controls; survey propellant laser ingredients and processes to determine availability and plan replacements; determine feasibility of smoke suppression by aerodynamic shaping and gas baffling. Aerodynamics - conduct wind tunnel and flight testing of small hypervelocity armor penetrator round; conduct full scale design and development testing of fiber optics guidance demonstration hardware; make preliminary concept studies for submissile airframe; update prediction methods for high maneuver air defense missile aerodynamics; evaluate effects of free stream nonuniformity on missile aerodynamics; participate in the Joint Army/Navy/NASA/Air Force (JANNAF) low altitude rocket plume model development; apply developed plume interference methodology to the advanced heavy antitank missile system (AHAMS) beam obscurance problem. Ground Support Equipment Technology - perform helicopter testing and evaluation of contractor fabricated vibration isolator; evaluate mallaunch detection device in flight testing; investigate launching techniques to permit firing from enclosures and to prevent detection; select concept and initiate design of automatic, rapid-fire launcher; perform design and analysis of under armor tracking station; evaluate composite container/launcher functional and structural performance and perform environmental tests.

Program Element: #6.23.03.A
DoD Mission Area: #144 - Guided Missiles and Rockets

Title: Missile Technology
Budget Activity: #1 - Technology Base

Nuclear Weapons Effects - finalize the correlation of cable driver electromagnetic pulse data to free-field radiation; finalize specialized studies on specific effects of nuclear radiation of missile components; initiate a program to consolidate developed techniques and approaches into a concise missile and rocket related nuclear hardening effort. Structures - continue search for liners/coatings to make filament wound composite launcher tubes reusable; demonstrate by flight firing the feasibility of large filament wound motor cases; experimentally determine potentialities and limitations of composite structures for missile system components such as fins, control surfaces, launcher members and warhead structures; complete evaluation of improved plastic radome materials; validate composite structures analytical programs utilizing empirical test data; develop and design analytical techniques for utilizing material damping properties in missile structures; develop optimal acoustical holography transducers and establish a three dimensional capability; apply modeling principals to interpretation of flight test data. Experimental Systems - begin critical components development of a fire and forget antitank seeker; field test passive radio frequency (RF) surveillance set; complete field tests of active radio frequency (RF) seeker; continue work on rifleman's assault weapon (RAW) and follow-through warhead; Systems Concepts and Analysis - extend force on force air defense tools to land combat applications; respond to system-level study requirements; support concept team technology evaluations; continue independent research and development information referral. Hybrid Microelectronics - complete design, fabrication, and demonstration of a digital autopilot; develop design, qualification, and repair procedures for large scale missile hybrids; demonstrate feasibility of a one-step automated design, analysis and fabrication system; develop design, fabrication, and assembly methods for making nonplaner circuit boards. Simulation Research - complete advanced hybrid operating system; complete interim RF distributed source simulation capability; continue Ku Band [redacted] hardware expansion; develop a target simulator for afterburning jet plume radiation; implement smoke effects simulation concepts; establish design concepts and facility requirements for a millimeter simulation system; continue long wave infrared capability expansion. Free Flight Rocket Technology - verify design of a demonstration motor via static tests and incorporate into launch/flight program; integrate low cost motor case, nozzle and foam launcher into demonstration program; use recoverable instrumentation package to measure mallaunch parameters; verify aerodynamic design with flight tests of demonstration rocket. Digital Technology - initiate development of target-machine independent compiler utilizing FY 1977 higher order language results for interim language; initiate reliable programming practices investigation toward programming standards and resultant software reliability improvement; in coordination with other Services, define a standardized communications common-buss structure for distributed microprocessors; support continued development of test bed. Sensors and Control for Guided Projectiles - develop hardened sensor components and sensor systems, noninertial roll rate systems, and control force generating techniques; establish mathematical models of projectile guidance loop components and error sources; investigate the peculiar aspects of projectile aerodynamics and control. High Energy Laser Research - complete work required for an operational closed cycle circulator system; install an electron beam gun; begin power loading tests at pounds; perform laser-supported detonation wave ignition experiments. Laser Technology - no work currently programed for FY 1978.

Program Element: #6.23.03.A Title: Missile Technology
DoD Mission Area: #144 - Guided Missiles and Rockets Budget Activity: #1 - Technology Base

3. FY 1979 Planned Program: Sensors - build and test a sidelobe, agile radar beam antenna and initiate processor design; develop acoustic brassboards for field testing; demonstrate lightweight beamrider guidance for military operations in build-up areas and test carbon dioxide (CO_2) beamrider guidance; fabricate and test brassboard millimeter beamrider sensor; complete tracking logic for indirect fire and specify parameters for far infrared (IR) and low cost IR sensors; complete tests of breadboard active radio frequency (RF) seeker; complete multienvironment active RF seeker fabrication and continue modeling of air defense suppression missile and antitank seekers; provide for transition of the hemispheric coverage antenna (HCA) from a low power antenna test bed into a high power, 360-degree hemispheric radar test bed (HRTB). (Development of the antenna was performed under Program Element 6.33.13, Missile/Rocket Components. Guidance and Control Technology - develop optimal trajectory and optimal signal processing for false target rejection, and implement all digital missile concept with pulse width modulator gyro for digital autopilot; develop inertial measuring unit (IMU), gyro compass, laser gyro and multisensor system and improve accelerometer design; complete evaluation of hardware-in-the-loop and flight test three guidance and control systems on simplified inertial guidance demonstration vehicle (SIG-D); flight evaluate internal bearing stabilized sight unit; and, perform flight evaluation experiments using automatic handoff from a target designation system to a "fire and forget" type missile. Terminal Guidance - integrate focal plane arrays coupled to a microprocessor controlled tracker; develop advanced air defense suppression missile concept based on current technology and previous analysis; perform flight validation of terminal guided submissile (TGSM) seeker hardware; explore alternate spectral regions (such as mid-infrared) as evolving laser component technology becomes available to demonstrate missile guidance feasibility; continue measurements and modeling in laser, infrared, millimeter areas; improve target recognition and tracking point measurement capability. Propulsion - complete low exhaust signature model/correlation; complete low exhaust signature beamrider-compatible motor feasibility demonstration; develop new low signature propellants/binders/plasticizers for improved thermal stability and aging; complete reliability/cost demonstration of an optimum low cost propulsion concept; initiate analog motor verification of service life prediction; investigate replacement ingredients compatibility, specifications and performance; evaluate selected noise suppression technique; optimize and characterize improved high burning rate propellant. Aerodynamics - refine small hypervelocity armor penetrator system (SPIKE) design and establish system performance; complete feasibility studies of SPIKE fire control and multiple launch; perform flight test of fiber optics guidance demonstration system; conduct wind tunnel test and ejection studies of submissile configurations; study high performance configurations for both portable and manportable air defense systems; conduct assessment of plume/electromagnetic interaction. Ground Support Equipment Technology - incorporate lightweight structures technology into airborne vibration isolator; demonstrate feasibility of selected low signature launch techniques; fabricate and test automatic, rapid-fire launcher components; perform detail design and component test of under armor tracking feasibility hardware; incorporate into container/launcher the most promising characteristics of components, materials and processes. Nuclear Weapons Effects - no work currently programed for FY 1979. Structures - incorporate composite structures technology into an "all plastic" missile structure and demonstrate feasibility; fabricate full scale radomes of selected materials, perform electromagnetic tests and determine hardness to high energy laser radiation; develop a computerized capability to enhance resolution of reconstructed acoustical holograms; develop structural response to random excitation analysis methods.

Experimental Systems - complete all tasks to permit rifleman's assault weapon (RAW) to enter advanced technology demonstration in 1980; complete critical components development of fire-and-forget antitank seeker. Systems Concepts and Analysis - implement smoke model for thin and thick obscurants; continue concept team support; assimilate independent research and development results into current research efforts. Hybrid Microelectronics - complete development and integrate automatic design system; develop a non-noble thick film conductor paste; demonstrate the size and weight reduction obtained by use of large scale hybrids. Simulation Research - initiate development of a millimeter simulation facility; complete implementation of distributed radio frequency (RF) target/clutter simulation hardware and software; complete development of an advanced system for automatically patching analog computers; complete development of afterburning jet plume simulator. Free Flight Rocket Technology - complete final design for accuracy/low cost demonstration rocket; fabricate and test rocket/launcher/vehicle demonstration system; complete plans for full range (20 kilometers) flight program at White Sands Missile Range (WSMR). Digital Technology - explore minimum cost code generation for standard compiler; initiate standards for reliable software production techniques; continue distributed processing applications (multi-Service); initiate development of interactive software design and test techniques. Sensors and Control for Guided Projectiles - continue development and testing of sensor systems, and control force generating techniques and systems; expand mathematical models of projectile guidance loop components and error sources; analyze circuit fabrication techniques. High Energy Laser Research - complete design and evaluation of advanced acoustic attenuator; begin single pulse contamination experiments in carbon dioxide (CO_2) laser gas; define best shroud contour for achieving desired cavity conditions. Laser Technology - no work currently programed. One hundred and eight-three professional and thirty-four support personnel are involved in this program.

4. FY 1980 Planned Program: Sensors - complete system design for a track-while-scan radar; establish requirements for an acoustical sensors system applicable to Army needs; conduct flight testing of carbon dioxide beamrider; perform development and flight testing of a millimeter seeker. Guidance and Control - use analytic tools, advanced digital technologies, and the flight proven data base developed in FY 1977-1979 to expand submissile concepts; develop trajectory shaping techniques to be applied to the use of combined submissile guidance and boost guidance; conduct flight evaluations to investigate problems associated with automatic target hand-off between noncompatible imaging systems; further develop internal bearing stabilized pointing and tracking system; continue work in the areas of low cost strapdown development, laser gyro development and multisensor development; evaluate new accelerometers and guidance schemes to improve performance, lower cost, and reduce reaction time, and perform sled tests to verify results. Terminal Guidance - demonstrate automatic target recognition of a variety of hardpoint targets through captive flight tests; conduct pattern recognition experiments with a modified millimeter tracker; make measurements to validate tracking algorithms; evaluate effects of experimental/advanced screening/camouflage smokes on sensors; perform flight tests with test vehicles guided by IR (infrared) seekers in the indirect fire mode. Propulsion - develop new bonding agents for HMX/RDX and stabilizers and evaluate for 10 year shelf life capability; provide analytical smoke prediction model to propulsion industry; evaluate dynamic and thermal survivability of the spinning plug nozzle in a high flame temperature environment; initiate demonstration of an air-augmented solid fuel ramjet propulsion system, demonstrate a low cost, braided fiberglass, case integral nozzle concept; initiate evaluation program for minimum signature prototype motor; expand the laser induced chemistry

laboratory capabilities for propellant synthesis. Aerodynamics - initiate a program to study advanced aerodynamic control techniques; complete feasibility demonstration programs for fiber optics guidance and hypervelocity antiarmor concepts; start a demonstration program to assess advanced concepts for air defense missiles. Structures - write manual on selection of missile system components for production fabrication using conventional and advanced composite materials; apply reusability technology to experimental structures designs; begin subscale flight testing of structural models; continue high energy laser damage effects program for radome structures; continue previous year's effort on elastic-plastic structural components; monitor independent research and development efforts of those companies assigned to the US Army Missile Research and Development Command to assure maximum utilization and benefit of this research to the Government; provide in-house analysis and definition of optional system approaches to documented weapons requirements. Ground Support Equipment Technology - finalize parameters and perform limited flight testing of airborne ground support equipment tactical hardware; conduct testing of large container/launcher pods to include firing, environmental and accuracy tests; conduct full-up container testing of a composite materials container followed by modeling and validation of design equations. Nuclear Weapons Effects - no efforts currently programed. Experimental Systems - complete hardware for a carbon dioxide (CO_2) beamrider flight demonstration; determine feasibility of an integrated lightweight night sight and beam projector unit; demonstrate feasibility of a mosaic array. Systems Concepts and Analysis - define future missile systems concepts; coordinate with US Army Training and Doctrine Command agencies to assure the integration of combat requirements and tactical concepts into advanced missile system planning. Hybrid Microelectronics - utilize a high density hybrid packaging technique in conjunction with large monolithic circuits in the miniaturization of a total guidance and control system such as COPPERHEAD (Designation for cannon-launched guided projectile); continue the investigation of flexible active devices. Simulation Research - continue and or complete efforts initiated in prior years and initiate development of a simulation capability for supporting the guidance system technology emerging in FY 1980. Free Flight Rocket Technology - demonstrate and evaluate previous technology accomplishments through an integrated accuracy/low-cost technology demonstration program consisting of rocket, launcher assembly and vehicle in full scale firings at White Sands Missile Range (WSMR). Digital Technology - continue higher order language work by designing a code generator using the optimized methodology that is transportable to contractor host compilers; continue work on a standard buss structure for distributed micro-processor communication. Sensors and Control for Guided Projectiles - confirm component design with high-g flight testing; initiate low cost sensor development for projectile terminal guidance; simulate new projectile guidance concepts. High Energy Laser Research - analyze, and conduct essential system oriented experiments; measure laser damage effects using short wavelength laser; address specific design technology requirements for high power free electron lasers. Laser Technology - no efforts currently programed.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A214-01 Title: Sensors Technology
Program Element: #6.23.03.A Title: Missile Technology
DoD Mission Area: #144 - Guided Missiles and Rockets Budget Activity: #1 - Technology Base

A. DETAILED BACKGROUND AND DESCRIPTION: This project is broken down into the following eight work areas: Advanced Radar Technology, Acoustic Sensing and Signal Processing, Optical Command and Beamrider, Millimeter Guidance Technology, Infrared Homing, Radio Frequency (RF) Guidance, Seeker Design and Signal Processing, and Hemispheric Radar Test Bed. The thrust of each work area is as follows: Advanced Radar Technology - develop techniques and procedures to reduce air defense vulnerability to the antiradiation missile (ARM) threat. Acoustic Sensing and Signal Processing - develop capability to locate, identify, detect and acquire land combat vehicles, and aircraft targets through infrared and acoustic techniques. Optical Command and Beamrider - develop optical command-to-line-of-sight and beamrider guidance technology on which to base future antitank and air defense systems. Millimeter Guidance Technology - demonstrate the technical feasibility of millimeter beamrider guidance for antitank applications. (Complementary work which includes an investigation of multipath effects and adverse weather effects is performed by the Ballistics Research Laboratory, Aberdeen Proving Ground, MD, in support of this work area). Infrared Homing - develop advanced infrared terminal homing capabilities for direct and indirect fire land combat and air defense roles. RF Guidance - establish a technology base in active and passive RF seekers. Seeker Design and Signal processing - support the development of improved sensors for air defense and antitank applications through the use of modeling, analysis and simulation. Hemispheric Radar Test Bed - provide for transition of the hemispheric coverage antenna, developed under Program Element 6.33.13, Missile/Rocket Components, into a high power, 360-degree Hemispheric Radar Test Bed. (This is a one time requirement only for FY 1979).

B. RELATED ACTIVITIES: Prototype sensors are subjected to field testing under the Experimental Systems technology area. Terminal homing sensors are validated in flight demonstration programs under terminal guidance technology. Foreign intelligence is considered in the planning and execution of this work. Coordination is continuously effected with US Navy and US Air Force development activities performing sensor research and development work through participation in periodic Department of Defense (DoD) reviews and discussions/conferences. Overall DoD coordination of technology base efforts in guidance and control is the mission of the Joint Service Guidance and Control Committee which was initiated in November 1976.

C. WORK PERFORMED BY: US Army Missile Research and Development Command, Huntsville, AL; Hughes Aircraft Corporation, Canoga Park, CA; RCA Corporation, Princeton, NJ; Raytheon, Bedford, MA; Texas Instruments, Inc., Dallas, TX; McDonnell Douglas Corporation, Saint Louis, MO; Teledyne-Brown Corporation, Huntsville, AL; Martin-Marietta Corporation, Orlando, FL; Sperry Microwave, Clearwater, FL; Georgia Institute of Technology, Atlanta, GA; Auburn University, Auburn, AL.

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

Project: #A216-01 Title: Sensors Technology
Program Element: #6.23.03.A Title: Missile Technology
DoD Mission Area: #144 - Guided Missiles and Rockets Budget Activity: #1 - Technology Base

1. FY 1977 and Prior Accomplishments: Advanced Radar Technology - examined reduced signature radar design alternatives versus threat; defined critical technology requirements; qualified clutter rejection capabilities of the reduced signature radar concept; completed antenna conceptual designs; initiated modification of HAWK Low Power Illuminator for vulnerability experiments. Acoustic Sensing and Signal Processing - completed survey of acoustic technology for weapons applications; initiated the development of an advanced signal processor for an infrared detection and acquisition (IRDA) system; modified existing in-house IRDA scanner head to accept new signal processor; initiated development of software to accommodate new IRDA signal processor. Optical Command and Beamrider - demonstrated Gallium Arsenide (GaAs) beamrider guidance; 38 missile flights, in three airframes, and antitank and air defense applications; demonstrated improved GaAs performance in several modes, electronic counter countermeasure environment and with sun in field of view; provided preliminary demonstration of carbon dioxide (CO_2) beamrider link; defined modular missile concept for antitank and limited air defense application. Millimeter Guidance Technology - completed in-house millimeter beamrider study; completed plan for millimeter guidance technology; and conducted field tests at US Army Missile Research and Development Command with available hardware (jointly with the Ballistics Research Laboratory). Infrared Homing - completed exploratory development for infrared (IR) imaging seekers; completed fabrication for multimaging sensors/seekers; developed sensor technology pods; initiated laboratory operation of two-dimensional IR array; finalized an analytical modeling approach for indirect fire IR land combat applications; purchased initial hardware for extreme IR and low cost IR sensors; provided support for thermal section of electrooptical simulation system; and, evaluated an alternate clutter test sensor for a field artillery weapon system. Radio Frequency Guidance - completed common aperture missile seeker (CAMS) experiments and analysis and defined breadboard hardware; fabricated breadboard active unit suitable for static and captive flight tests; completed fabrication and initial captive testing of CAMS for air defense suppression missile; completed breadboard fabrication of multienvironment active radio frequency seeker and initiated static testing; completed fabrication of (CBr) seeker and side-by-side testing of (m monostatic, bistatic, and radiometric modes; completed captive testing of line-of-sight/antiradiation homing and CAMS-BRAZO (Navy AntiRadiation Missile) type seekers; completed simulation models and initiated circular error probable (CEP) analysis for RF-only antiradiation missile; performed feasibility assessment and initiated design of millimeter beamrider missile system; performed feasibility tests and analysis for antiradiation projectile. Seeker Design and Signal Processing - provided simulation and analysis of seeker signal processing against interfering signals for the ROSETTE seeker program and the Army's Special Electromagnetic Interference (SEMI) Program; completed in-house design, fabrication, and programing of a microprocessor tracker; developed correlation and centroid tracking algorithms; demonstrated real-time software tracking algorithms with charged coupled device (CCD) camera and microprocessor.

2. FY 1978 Program: Advanced Radar Technology - quantify vulnerability of modified radar with reduced signature; establish design of low sidelobe, agile beam antenna. Acoustic Sensing and Signal Processing - Complete testing of advanced signal processor and document results; refine target signature data base, quantify atmospheric propagation effects, and define application concepts. Optical Command and Beamrider - develop improved coding techniques; investigate feasibility of alternate

spectral regions; demonstrate degraded environment performance of improved Gallium Arsenide (GaAs) guidance; complete static evaluation of carbon dioxide beamrider. Millimeter Guidance Technology - establish accuracy and resolution at [redacted]; in coordination with the Ballistics Research Laboratory, determine effects of multipath scattering at [redacted] design antenna configurations for both tracking and guidance; design track and guidance links and perform parametric analysis. Infrared Homing - evaluate infrared (IR) imaging seeker with advanced tracker; evaluate available nonimaging sensors for land combat and air defense; specify seeker configuration for nonimaging land combat and/or air defense application; procure and laboratory test additional two-dimensional IR arrays; initiate test of extreme IR and low cost IR sensors; update analytical modeling based on field test results; initiate advanced signal processing investigations utilizing microprocessors for indirect fire IR homing. Radio Frequency Guidance - conduct breadboard active seeker static and captive flight tests; develop simulation models and initiate active seeker performance evaluation; complete common aperture multispectrum seeker captive flight tests and perform six degree of freedom (Six-DOF) missile simulation of air defense suppression missile; conduct static and captive flight tests of multienvironment active radio frequency seeker and initiate design and fabrication of brassboard hardware; develop simulation models and perform multienvironment active RF seeker six degree of freedom (Six-DOF) simulation; finalize millimeter seeker design and initiate hardware fabrication for drop tests; continue feasibility analysis and tests of projectile seekers. Seeker Design and Signal Processing - continue evaluation of tracking algorithms applicable to imaging seekers; improve digital data displays and data handling capability for imaging seekers; develop models of both electrooptical and millimeter sensors applicable to beamrider missile guidance; provide simulation support for ROSETTE seeker design improvements.

3. FY 1979 Planned Program: The planned program will reach a peak emphasis on breadboard, brassboard or test bed evaluation of ten different sensor/seeker approaches based upon radio frequency, millimeter wave, infrared, electrooptical, and acoustic capabilities. Most of these components will be at a level of development to transition into advanced development, system application or terminate at the end of FY 1979 or FY 1980. Major mission capabilities are directed at antitank, air defense suppression, or air defense counter countermeasures applications. Advanced Radar Technology - Build, test, and evaluate low sidelobe, agile beam antenna; refine capabilities of modified radar with reduced signature; record radar returns and process returns in laboratory; begin implementation of optimum processor; plan follow-on demonstration program. Acoustic Sensing and Signal Processing - perform simulation of sensing system concepts; develop brassboard hardware for field test and evaluation; conduct field and captive flight tests; expand technology base. Optical Command and Beamrider - complete static demonstration of lightweight beamrider guidance for military operations in built-up areas application; conduct tests of carbon dioxide beamrider guidance in degraded environments. Millimeter Guidance Technology - develop test and evaluate brassboard millimeter beamrider; initiate development of experimental hardware at shorter wavelengths. Infrared homing - complete nonimaging longer wavelength infrared sensor/seeker; evaluate two-dimensional array technology in seeker configuration; specify guidance sensor parameters for extreme infrared (IR) and low cost IR sensors; complete advanced tracking logic for indirect fire; and evaluate two-dimensional infrared (IR) arrays for strapdown applications. Radio Frequency Guidance - complete captive flight tests of breadboard active seeker; evaluate active seeker designs and potential for system application; complete multienvironment active radio frequency

seeker brassboard fabrication; continue modeling and simulation for air defense suppression missile and antiarmor; initiate projectile seeker development; complete millimeter seeker fabrication and initiate drop tests. Seeker design and signal processing - integrate microprocessor/tracker with infrared focal plane arrays; continue modeling efforts for either millimeter or electrooptical sensors. Hemispheric Radar Test Bed - provide for transition of the hemispheric coverage antenna from a low power antenna test bed into a high power, 360-degree hemispheric radar test bed. Twenty-six professional and six support personnel are involved in the program.

4. FY 1980 Planned Program: Advanced Radar Technology - complete system design of track-while-scan quiet radar and integrate solid state X-band transmitter; complete second generation process for quiet radar; begin integration of track-while-scan radar. Acoustic Sensing and Signal Processing - establish requirements for an acoustical sensors system applicable to Army needs; initiate development on contract for prototype acoustical system; maintain technology base in infrared detection and acquisition. Optical Command and Beamrider - conduct flight tests on carbon dioxide beamrider. Millimeter Guidance Technology - conduct flight test on millimeter beamrider. Infrared Homing - specify two-dimensional seeker for indirect fire evaluation; specify a strapdown guidance seeker for utilizing an integrated focal plane array; evaluate extreme IR and low cost prototype seeker hardware; assess state-of-the-art of multispectral integrated focal plane array technology for target discrimination and its potential for Army tactical guidance application. Radio Frequency (RF) Guidance - conduct millimeter seeker development and flight tests; complete multienvironment active radio frequency seeker development and flight tests; conduct multimode guidance development for air defense. Seeker Design and Signal Processing - complete performance analysis of millimeter beamrider; prepare specifications on image processing; fabricate a silicon on sapphire digital logic tracker using distributed processing.

5. Program to Completion: This is a continuing program.

6. Major Milestones: Not Applicable.

7. Resources ($ in thousands):

	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
RDTE,A: Funds	4295	4445	5459	5323	Continuing	Not Applicable

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.01.A
DoD Mission Area: #149 - Land Mobility Technology

Title: Tank and Automotive Technology
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	6767	6370	10262	10770	Continuing	Not Applicable
AH91-01	Combat Vehicle Systems	2068	1614	3167	4195	Continuing	Not Applicable
AH91-02	Combat Vehicle Survivability	1824	2200	3590	3500	Continuing	Not Applicable
AH91-03	Advanced Tactical Vehicle Systems	1130	608	120	500	Continuing	Not Applicable
AH91-04	Advanced Military Propulsion Systems	805	530	720	800	Continuing	Not Applicable
AH91-05	Component Development	800	1420	2275	2775	Continuing	Not Applicable
AH91-06	Structure Mechanics	120	0	0	0	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army, as a ground combat force, must have ground combat vehicles equal to or superior to all potential adversaries. These combat vehicles must be supported by logistical cargo vehicles capable of resupply under all conditions. This program provides the technology base whereby such military un s vehicles and their components can be developed. In order for timely development of new battlefield vehicles at minimal cost, time and risk, new components and vehicle system approaches are first explored for technical feasibility within this program. New techniques for improving vehicle survivability receive their genesis in this exploratory development program to demonstrate feasibility prior to incorporation in actual vehicles.

C. BASIS FOR FY 1979 RDTE REQUEST: To investigate and exploit technology for improving the effectiveness of combat vehicles; to provide prototype hardware for improving combat vehicle survivability; to conduct research to achieve significant reduction in fuel consumption of vehicles and to extend their fuel tolerance; to investigate mechanical and electrical components that will improve the performance of combat and tactical vehicles; and to develop the methodology of synthesizing the vehicle dynamics operating environment in the laboratory for the purpose of accelerating testing and reducing field test costs.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The fielding of qualitatively superior military vehicles requires that technology be developed well in advance of expected operational requirements. The objective of this program element is to develop that technology required in ground vehicles which will (1) produce combat and other ground vehicles that have the capability to defeat

prospective threats in any specified operational environment; (2) minimize the total costs of these systems; (3) reduce time and risks of new development; and (4) increase survivability and efficiency.

F. RELATED ACTIVITIES: Specific programs related to the technical areas of this program element (PE) are: PE 6.11.02.A, Project F22, Research in Vehicle Mobility; PE 6.21.05.A, Materials; PE 6.26.03.A, Large Caliber and Nuclear Technology; PE 6.27.33.A, Mobility Equipment Technology; PE 6.26.18.A, Ballistics Technology; PE 6.31.02.A, Materials Scale-up; PE 6.32.01.A, Aircraft Power Plants and Propulsion; PE 6.36.08.A, Tank Gun Development and Tank Ammunition; PE 6.36.21.A, Vehicle Engine Development; PE 6.36.24.A, Mobility; PE 6.23.79.A, Test Measurement and Diagnostic Equipment; and PE 6.36.02.A, Advanced Land Mobility System Concepts. Close relationship is maintained with other Services and Governmental agencies. Research and development information concerning Combat, Tactical and Special Purpose Vehicles is also being exchanged via data exchange agreements with allied countries. Exchange of technical reports and frequent liaison by all agencies concerned occurs to insure coordination and avoids duplication of effort. Increased emphasis is being placed upon close collaboration with NATO countries.

G. WORK PERFORMED BY: US Army Tank-Automotive Research and Development Command, Warren, MI, has the responsibility for the implementation of this program. Other Army in-house developing organizations that support this program are: US Army Test and Evaluation Command, Aberdeen, MD; Waterways Experiment Station, Vicksburg, MS; and Cold Region Research and Engineering Laboratory, Hanover, NH. Major ontractors participating in the program are: Stevens Institute of Technology, Hoboken, NJ; Purdue University, Lafayette, IN; General Motors, Detroit, MI; Wayne State University, Detroit, MI; National Waterlift Company, Kalamazoo, MI, Lockheed Corporation, Huntsville, AL; Williams Research Laboratory, Walled Lake, MI; Chrysler Corporation, Detroit, MI; and Systems Consultants, Inc., Washington, DC.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: The Gas Turbine engine currently in the XM1 Tank had its genesis in this program. Additional validation of "behind-the-plate" effects of antipersonnel and high explosive antitank (HEAT) rounds was completed and a users manual prepared. Technical support was provided during fabrication of the High Mobility/Agility Test Vehicle (HIMAG) chassis, as well as design and fabrication of the turret, weapon pod and fire control system. Several advanced survivability test bed studies were completed. Automatic defense system efforts, such as the determination of the feasibility of acoustic detection of attack helicopters by buttoned-up combat vehicles and construction and field test of an automatic threat detection and discriminator system, warning display, and countermeasure selection system was accomplished. A radar signature acquisition system was fabricated and employed to measure the cross-section of several absorbing materials in the role of passive countermeasures. An acoustic signature reduction program was initiated. The first generation survivability optimization model was accomplished. A survey was initiated to define the Chemical Bacteriological and Radiological (CBR) protection systems for each vehicle type. The design of two cargo versions of the 10-ton High Mobility Tactical Trucks (HMTT) was completed. Development was initiated for minimum cooled ceramic component diesel engines.

2. FY 1978 Program: Efforts initiated in FY 1977 will be continued. New systems integration approaches to combat vehicles will be explored and future concepts proposed. The Automatic Defense System will continue development to demonstrate feasibility. Efforts to enhance combat vehicle survivability will occur. Turbine component research will continue to increase flexibility and efficiency of turbine engines. A new approach to suspensions, the loopwheel, will begin fabrication. The in-arm suspension system will be fabricated which will permit reduction of combat vehicle height and increase interior space available. Exploratory development of a minimum cooled ceramic engine will be initiated. Improved track designs for light armored vehicles will complete exploratory development. New approaches to weapon station design will be initiated.

3. FY 1979 Planned Program: Efforts initiated in FY 1978 will be continued and new efforts started. Ballistic evaluation on new candidate materials for armored vehicle application will be initiated. Additional efforts to provide advanced countermeasures will occur. Efforts to examine compartmenting of combat vehicles will be initiated. Hardware fabrication of Advanced Turbine components will be initiated. Fabrication of a diesel engine employing ceramics will occur to demonstrate technical feasibility. The incorporation of nonmetallic materials into vehicle components to increase strength and reduce weight will be examined. Development of new track rubber components will be initiated. The increase in funding over FY 1978 is due to design engineering efforts for hardware fabrication of advanced turbine components and the radical new approaches to rapid fire terminal homing defensive weapons system, and hardware fabrication of advanced techniques to enhance military vehicle survivability.

4. FY 1980 Planned Program: Prior efforts will be continued and new programs initiated. The 27- to 45-ton variable parameter test bed vehicle support will be continued to the completion of test programs. Prototype structures will be fabricated and tested for development of optimum energy absorption systems against mine blasts. Automatic Defense System concept designs for vehicle application will be completed and prepared for user evaluation. Design of countermeasures to reduce vulnerability will be expanded to encompass new threat areas and provide maximum military effectiveness. The survivability optimization model will be fully operational. Chemical Bacteriological Nuclear (CBN) protection systems integration of most effective protection devices will be accomplished.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.03.A
DoD Mission Area: #145 - Guns and Related Technology

Title: Large Caliber and Nuclear Technology
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT					Continuing	Not Applicable
AH18-01	Armored Fighting Vehicles (Large Caliber Systems)					Continuing	Not Applicable
AH18-02	Armored Fighting Vehicles (Medium Caliber Vehicles)					Continuing	Not Applicable
AH18-03	Armored Fighting Vehicles (Precision Armaments)					Continuing	Not Applicable
AH18-04	Infantry Armament Systems					Continuing	Not Applicable
AH18-05	Artillery Armament Systems					Continuing	Not Applicable
AH18-06	Artillery Closed Loop Fire Control Systems					Continuing	Not Applicable
AH18-07	Combat Aviation/Air Defense					Continuing	Not Applicable
AH18-08	Combat Engineer Armament Support					Continuing	Not Applicable
AH18-09	Energetic Materials Technology					Continuing	Not Applicable
AH18-10	Weapons Technology					Continuing	Not Applicable
AH18-11	Munitions Technology					Continuing	Not Applicable
AH18-12	Weapons Munitions Interface					Continuing	Not Applicable
AH18-13	Nuclear Munitions Technology (FY 1977 PE 6.26.15.A)					Continuing	Not Applicable
AH18-14	Fuze Technology FY 1977 PE 6.26.16.A FY 1978 PE 6.21.20.A					Not Applicable	Not Applicable
AH78	Armament Technology					Not Applicable	Not Applicable
AH79	Munitions Technology (FY 1977 PE 6.26.17.A)					Not Applicable	Not Applicable

Program Element: #6.26.03.A
DoD Mission Area: #145 - Guns and Related Technology

Title: Large Caliber and Nuclear Technology
Budget Activity: #1 - Technology Base

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is to develop and maintain a technology base upon which advanced and engineering development of major caliber weapon systems and munitions can be initiated and sustained.

C. BASIS FOR FY 1979 RDTE REQUEST: These funds will support the development and maintenance of a large caliber weapon systems technology base encompassing the technical areas related to propellant charges, cannons, projectiles, fuzes and other munitions.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The Large Caliber and Nuclear Technology project performs exploratory development and necessary supporting research in weapons and munitions technology. The product of this effort is used to conceptualize revolutionary weapon and munitions systems as well as define ways of product improving the current systems to extend their useful life. The program scope covers the system oriented technical areas embracing armor, infantry, field artillery, air defense artillery, aviation, combat engineering and the support technologies of energetic materials (explosives, propellants, and pyrotechnics), weapons, conventional munitions, nuclear munitions and weapon/munition interface. The investigations develop both hardware and analytic tools to assess system performance and identify problem areas. The resulting data base forms the foundation for all subsequent large caliber weapon and munition advanced and engineering developments.

F. RELATED ACTIVITIES: Prior to FY 1978, the activity in this area was conducted in Program Elements 6.26.03.A (AH78), Armament Technology; 6.26.17.A (AH79), Munitions Technology; 6.26.15.A (AH 74), Nuclear Munitions; and 6.26.17.A (AH 77), Fuze Technology. During FY 1978, fuze technology efforts were conducted in Program Element 6.21.20.A (Fuze, Nuclear Weapon Effects, Fluidics). Technical areas of this program for FY 1979 are related to Program Elements 6.26.17.A, Small Caliber and Fire Control Technology, 6.26.18.A, Ballistics Technology, and numerous advanced and engineering development projects. Coordination of similar efforts conducted by the Air Force and Navy is accomplished by visits of technical personnel, interagency meetings, and Tri-Service reviews and workshops to encourage cross-fertilization and preclude unnecessary duplication.

G. WORK PERFORMED BY: In-house work is conducted at the US Army Armament Research and Development Command facilities located at Dover, NJ, Aberdeen, MD, and Edgewood, MD. Contract support is provided by Aircraft Armaments, Inc., Cockeysville, MD; Aerojet, Azusa, CA; AVCO, Wilmington, MA; Batelle Memorial Institute, Columbus, OH; Calspan, Buffalo, NY; Chamberlain, Waterloo, IA; Firestone, Akron, OH; Ford-Aerospace and Communications, Newport Beach, CA; Honeywell, Hopkins, MN; Northrop, Anaheim, CA; Sanders Associates, Nashua, NH; Space Research Corporation, Troy, VT; Texas Instruments, Dallas, TX; and numerous other small contractors.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Studies and tests were performed on numerous extended range artillery munition concepts. Medium caliber anti-armor automatic cannons were demonstrated with burst fire which can defeat tank armor. Cannon-

launched beam rider projectile components were fabricated and successfully tested which show promise of significantly increasing the probability of hit. Techniques which can significantly reduce propellant ignition delay and variance were demonstrated. Alternative explosive fills for all high use munitions were developed and qualified for use during mobilization. The design, fabrication and installation of an automated gun laying system was completed in an M109A1 howitzer during the 4Q FY 1977. Terminal ballistic performance testing of high velocity medium caliber kinetic energy projectiles was completed. Laser link guidance was successfully demonstrated under blast, smoke, and haze environments for the Cannon Launched Beam Rider Projectile (CLBRP). 155mm projectiles were successfully fired with non-metallic rotating bands. Millimeter wave radiometer tests confirmed feasibility as a sensor for the SADARM (Search and Destroy Armor) artillery projectile. Analytical and simulation results indicated that the fire-and-forget artillery projectile CHAMP (Command Homing Artillery Modular Projectile) will meet its performance objective. Extended range artillery projectile concepts were demonstrated which provided a basis for the FY 1979 program. Potential methods improving warhead effectiveness and propellant formulations were investigated. Fabrication of a model demonstrating new safing and arming devices was initiated in FY 1977.

2. FY 1978 Program: Feasibility demonstrations of SADARM and STAFF (Smart Target Actuated Fire and Forget) projectiles will be conducted. The STAFF is a highly promising direct fire anti-armor projectile which eliminates the necessity for precise aiming and tracking by a gunner. Baseline designs, hardware fabrication, and flight tests will be completed for the CLBRP. Test and evaluation of a "fire-on-the-move" miss distance sensor for tanks will be performed. The automatic gun laying system howitzer will be evaluated at the artillery school in Ft. Sill, OK. A second test bed vehicle will be fabricated which incorporates full on-board fire control and location reference capability. A compressible fluid recoil mechanism will be fabricated and tested. Tests of energetic materials and propellants will continue to increase performance and reduce vulnerability. Reduction of gun tube wear and erosion will be studied and tested through analysis of propellant additives, use of plating or gun tube liners, and alternate projectile rotating bands. Efforts will continue on a unique safe and arm device for nuclear weapons.

3. FY 1979 Planned Program: The "fire-on-the-move" miss distance sensor will be integrated with an M60 tank for test firings. CLBRP subsystem concepts will be investigated to incorporate technology advances for operations in low-visibility conditions. Baseline configurations for an advanced self-propelled howitzer will be formulated which incorporates the most recent technology to increase rate-of-fire, accuracy, and survivability. SADARM will be subjected to a full-up, live warhead demonstration. The automatic gun laying howitzer test vehicles will become part of a BLAST (Battery Level Automated System Technology) test bed configuration. Improved mine counter-measure features will be evaluated, and a dual influence ground based sensor for stand-off mines will be demonstrated. Tests of energetic materials and propellants will continue to reduce wear, increase performance, and reduce vulnerability. A liquid propellant will be synthesized for potential use in artillery and high velocity weapons. A small-scale test fixture will be fabricated and tested for velocity and pressure uniformity. A "low-G" sensor will be integrated into a unique signal generating safe and arm device for nuclear munitions. Studies of radio frequency (RF), optical, and electrostatic fuze concepts will be conducted. Funding changes from FY 1978 are the result of revalidated priorities.

Program Element: #6.26.03.A
DoD Mission Area: #145 - Guns and Related Technology

Title: Large Caliber and Nuclear Technology
Budget Activity: #1 - Technology Base

4. FY 1980 Planned Program: Exploratory development of a closed loop fire control system for artillery will be completed and transitioned into advanced development. Field tests of guidance links for Cannon Launched Beam Rider Projectile (CLBRP) will be conducted. Guided mortar projectile feasibility will be analyzed. A full-up feasibility firing demonstration of Command Modular Projectile (CHAMP) will be performed. Tests of the liquid propellant fixture will continue. Improved propelling charge and warhead design will be evaluated based on technology efforts of FY 1978 and FY 1979. Programs to improve reliability, availability and maintainability aspects of nuclear munitions will be investigated. Fuzing concepts for hypervelocity automatic cannons will be formulated.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.17.A
DoD Mission Area: #145 - Guns and Related Technology

Title: Small Caliber and Fire Control Technology
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	12836	10523	9471	6851	Continuing	Not Applicable
AH19-01	Combat Vehicle Armament	3351	2660	2340	1851	Continuing	Not Applicable
AH19-02	Aircraft Armament	830	575	400	300	Continuing	Not Applicable
AH19-03	Light Weapons	1600	1451	1067	600	Continuing	Not Applicable
AH19-04	Short Range Air Defense	2100	2010	1600	900	Continuing	Not Applicable
AH19-05	Fire Control Technology	2450	850	1481	1300	Continuing	Not Applicable
AH19-06	Armament Technology	3535	2977	2585	1900	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is to develop and maintain a technology base upon which advanced and engineering development of fire control and small caliber weapons and munitions can be initiated and sustained. The focus is on exploratory development in munitions, weapons, and fire control technology intended to solve critical problems in cartridge design, projectile effectiveness, weapon rate-of-fire, and fire control technology. The intent is to produce an integrated program of analysis, experiment, and test demonstration that advances the state-of-the-art and lead to concept validation.

C. BASIS FOR FY 1979 RDTE REQUEST: These funds will support the development and maintenance of a small caliber and fire control technology base encompassing the technical areas related to armament for combat vehicles and personnel. Efforts are focused on the areas listed above.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The Small Caliber and Fire Control Technology project performs exploratory development and necessary supporting research in weapons and munitions technology. The product of this effort is used to conceptualize revolutionary weapon and munition systems as well as define ways of product improving the current systems to extend their useful life. The program scope covers the system oriented technical areas of combat vehicles, aircraft armament, infantry weapons, air defense, and the base technology areas embracing fire control and armaments technologies. The investigations develop both hardware and analytic tools to assess system performance and identify problem areas. The resulting data base forms the foundation for all subsequent small caliber weapon, fire control, and munition advanced and engineering developments.

Program Element: #6.26.17.A
DoD Mission Area: #145 - Guns and Related Technology

Title: Small Caliber and Fire Control Technology
Budget Activity: #1 - Technology Base

F. RELATED ACTIVITIES: Prior to FY 1978, the activity in this area was conducted in Program Elements 6.26.03.A (AH78), Armament Technology; and 6.26.17.A (AH79), Munitions Technology. Technical areas of this program for FY 1979 are related to Program Elements 6.26.03 (AH16), Large Caliber and Nuclear Technology; 6.26.18.A, Ballistics Technology; and numerous advanced and engineering development projects. Coordination of similar efforts conducted by the Air Force and Navy is accomplished by visits of technical personnel, interagency meetings, and tri-service reviews and workshops to encourage cross fertilization and preclude unnecessary duplication.

G. WORK PERFORMED BY: In-house work is conducted at the US Army Armament Research and Development Command facilities located at Dover, NJ; Aberdeen, MD; and Edgewood, MD. Contract support is provided by Aircraft Armaments, Inc., Cockeysville, MD; Battelle Memorial Institute, Columbus, OH; Honeywell, Hopkins, MN; and numerous other small contractors.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Low Dispersion Automatic Cannon test beds successfully demonstrated the concept that high impulse automatic guns can be controlled to assure pinpoint burst accuracy. Salvo rifle prototypes demonstrated the relationship between impulse and burst rate permitting more advanced rifles and machineguns to be developed without a trial and error approach. Closed loop fire control techniques were investigated and found to offer substantial gains in gun performance of all calibers. Several promising methods of reducing the size and cost of small caliber ammunition were identified and demonstrated. Preliminary design of extended range search and track systems was completed.

2. FY 1978 Program: Fabrication and system integrations will be initiated on a multi-function fire control test bed. Initial evaluation of a carbon dioxide (CO_2) laser range finder/designator. Initial analysis of a dual purpose, high explosive, retro-reflective, round. Analysis of new weapon and ammunition concepts to improve performance and reduce weight. Exploratory development will begin on a Future Automatic Cannon System (FACS). User conceptual tests will be conducted on an advanced rifle system using the Salvo Bullet Rifle concept. Investigate and establish detail designs and perform characteristics for low-drag HE projectile designs including consolidated propellant charge and reduced erosion propellants. Technological problems of a universal nature to the accomplishment of the fire control mission will be addressed. Those areas having broad application to the ground-to-ground, ground-to-air, air-to-ground, and air-to-air scenarios will be emphasized. In particular, automatic target cueing of potential targets will be explored. Unique and novel means of implementing automatic target tracking via a combination of electro-optic and microprocessor technologies will be exploited.

Program Element: #6.26.17.A
DoD Mission Area: #145 - Guns and Related Technology

Title: Small Caliber and Fire Control Technology
Budget Activity: #1 - Technology Base

3. FY 1979 Planned Program: Fabrication and system integration of the multifunction fire control test bed will be completed. Fabrication with testing of the carbon dioxide (CO_2) laser range finder/designator. Exploratory development with the FACS will be completed and transitioned into advanced development. Design alternatives for thin walled cartridge cases will be evaluated. The HE/HEDP retro-reflective round design will be completed. Breadboard design, fabrication, and testing of automatic target cueing for fire control will be accomplished. Optical coatings and reliable optical bonding means will be explored toward improving the optical efficiency and mechanical integrity of fire control optical elements. Investigation of methods to attenuate and control recoil forces will be continued with the effort concentrated on development of concepts and devices which showed most potential during FY 1978. Refinements will be made to the techniques for synthesizing a weapon mechanism, for sensitivity analysis and optimization, and for automating mechanism designs. Optimum gas generation control techniques will be demonstrated. New liquid propellant design concepts will be established. Assess material properties and processing techniques for advanced muntions concepts.

4. FY 1980 Planned Program: The multi-function fire control test bed will complete field tests. Concept studies for millimeter radar, improvements to the multi-function test bed, automatic cueing, and improved stabilized sights will be initiated in a system context. Conceptual breadboard hardware will be designed to support system definitions of new individual weapons. Nitramine based propellant studies will be conducted. A solid caseless ammunition state-of-the-art survey will be conducted. Weapon/ammuniton/propellant interfacing will be studied using higher volumetric impetus propulsion systems. Continue efforts with innovative materials and processing techniques.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.18.A
Title: Ballistics Technology
DoD Mission Area: #145 - Guns and Related Technology
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	18133	17507	18309	17570	Continuing	Not Applicable
AH80-01	Propulsion Dynamics and Interfacing	2695	2605	3500	3500	Continuing	Not Applicable
AH80-02	Launch and Flight Dynamics	1500	690	900	900	Continuing	Not Applicable
AH80-03	Firing Table Techniques and Production	850	800	898	900	Continuing	Not Applicable
AH80-04	Warhead Mechanics	2409	3710	2830	2500	Continuing	Not Applicable
AH80-05	Terminal Effects and Armor Dynamics	3793	4597	4231	2470	Continuing	Not Applicable
AH80-06	Armor Vulnerability Technology	0	0	0	1800	Continuing	Not Applicable
AH80-07	Target Vulnerability and Lethality	2920	2295	2250	2000	Continuing	Not Applicable
AH80-08	Vulnerability Reduction and Survivability	780	565	1000	1000	Continuing	Not Applicable
AH80-09	Weapon Systems Analysis and Modelling	1916	1470	1600	1500	Continuing	Not Applicable
AH80-10	Advanced Technology Concepts		1270	775	1100	1000	Continuing

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is to develop and maintain a ballistics technology base assuring a solid foundation upon which advanced and engineering development of weapon systems can be initiated and sustained. The focus is on exploratory development in support of the armaments laboratories and the solution of critical problems in propelling charge design, armor penetration, vulnerability to fire, and warhead effectiveness. The intent is to produce an integrated program of analysis, experiment, and test demonstration that emphasizes advanced concepts in the technical areas of ballistics.

Program Element: #6.26.18.A
DoD Mission Area: #145 - Guns and Related Technology

Title: Ballistics Technology
Budget Activity: #1 - Technology Base

C. BASIS FOR FY 1979 RDTE REQUEST: This program will support the continued development of a ballistics technology base, exploitation of significant technological opportunities in armor design, shaped charge warheads and gun propulsion design, and the conduct of tests and analysis to reduce vulnerability of weapon systems.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The Ballistics Technology Program focuses on describing closed system combustion processes (interior ballistics), interactions between the launching mechanism and projectile (transitional ballistics), dynamics of projectile flight (exterior ballistics), and the coupling of the projectile and target (terminal ballistics). The ability to comprehensively describe ballistic phenomena is of critical importance to the successful prosecution of advanced and engineering development of weapon systems. State-of-the-art concepts can be identified, developed and evaluated without resorting to costly and time consuming trial-and-error methods. In addition, the Ballistics Technology Program develops vulnerability assessment techniques which are used by Army-wide developmental activities to identify system weaknesses and appropriate design changes prior to production. This formalized vulnerability assessment/vulnerability reduction effort has led to improved survivability of recently developed Army materiel, and defines weaknesses in enemy equipment which are exploited by weapons designers.

F. RELATED ACTIVITIES: Ballistic technology efforts conducted in this program are related to developmental activity in program elements 6.26.03.A, Large Caliber and Nuclear Technology; 6.26.17.A, Small Caliber and Fire Control Technology; and 6.26.01.A, Tank and Automotive Technology. In addition, Ballistics Technology efforts are related to similar efforts conducted by the Air Force and Navy. Coordination is accomplished by visits of technical personnel, interagency group meetings, and Tri-Service workshops to encourage cross-fertilization of ideas and preclude unnecessary duplication of efforts.

G. WORK PERFORMED BY: In-house work is conducted at the US Army Research and Development Command facilities located at Aberdeen, MD; Dover, NJ; and Edgewood, MD. Contract support is provided by Falcon Research and Development, Denver, CO; Honeywell, Hopkins, MN; Energy Research and Development Administration, Oak Ridge TN; Lawrence Livermore Laboratories, San Francisco, CA; Firestone Tire and Rubber, Akron, OH; Thiokol Corporation, Brigham City, UT; and numerous other small contractors.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Development activities in this program have contributed to significant advances in armor design, warhead design and vulnerability analysis. Techniques have been developed which provide for more accurate and detailed study of both interior and exterior ballistics. Techniques and equipment have been developed which allow photographic observations of the ignition surface of liquid monopropellants under high pressure. A test facility has been designed and constructed for measuring in-bore projectile motion, in-bore pressure environment, muzzle velocity, and projectile

profile on tube exit. Computational capabilities for aerodynamic flow evaluations have been developed which provide a valuable tool for projectile flight stability analysis. During FY 1977 a comprehensive analytical/experimental investigation of fragment shape effort on lethality was completed. Advancements were made in the description process of high priority targets for vulnerability and lethality analysis. Testing has been initiated on a conceptual blast suppressor capable of reducing blast overpressure at crew locations. A 140 Gigahertz (GHz) tracking radar was fabricated and demonstrated high tracking accuracy of armored targets. A segment of these tests were conducted jointly with MIRADCOM.

2. FY 1978 Program: Advanced propellant technology will be applied to increase performance and decrease vulnerability of high-velocity ammunition. The in-bore dynamics model will be validated to develop a predictive description of the interface conditions between projectile, tube, and mount while the projectile travels in-bore. A high length to diameter ratio, cargo-carrying projectile with a non-conical boattail which provides stable flight at all velocities, increased accuracy, and increased range will be test flown. New mechanisms of controlled fragmentation mechanisms will be examined for technical feasibility. New techniques which tailor the kinetic energy distributions of shaped charge warheads will be evaluated. Investigations of design concepts to minimize damage to armored vehicles produced by deflagrations in munition storage compartments will be continued. Expanded emphasis will be placed on determining the vulnerability of logistical and tactical targets including generation of target description and probability of path through automation. Parametric analysis of lethality rescue range for conceptual extended range artillery ammunities will be completed.

3. FY 1979 Planned Program: A comparison of three major propulsions schemes--travelling charge, consolidated propellant, and liquid propellant charge will be completed. Emphasis will continue on the applications of modelling to minimize and control erratic launch behavior of projectiles; the aerodynamics of special projectile shapes; and verification of flight dynamics models. Effort will continue on reduction of munitions sensitivity and improvement of fragmentation effects. Use of composite materiels for improved kinetic energy will be studied. Analysis will continue for determining vulnerability and effectiveness of ordnance materiel and target arrays to assist in assessing lethality of developmental munitions. Vulnerability studies will be developed to provide the basis for recommendations to increase survivability of command, control, and communications elevate. Projectiles with higher striking velocities will be evaluated. The 140 GHz tracking radar will be tested to determine performance with air defense and anti-armor gun systems. Changes in project funding levels from FY 1978 are the result of revalidated priorities.

4. FY 1980 Planned Program: Emphasis will continue on generation and application of advanced ballistic technology to propellants and reduction of wear through improved charge design. Ballistic range tests will be conducted to confirm aerodynamics performance of unusual shaped projectiles and special purpose shells. Techniques will be optimized to improve fragment beam control and to counter the effectiveness of anti-armor warheads. Armor dynamics efforts will emphasize: modelling of structural response; hyper-velocity projectile technology; and methodology for blast wave propagations and predictions. Vulnerability data will be developed for a broad spectrum of materiel and equipment. The benefits of vacious vulnerability

reduction techniques will be quantified. Specific milestones will be established in development and application of millimeter wave radar to aircraft tracking and in particle beam technology.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.22.A
DoD Mission Area: #135 - Chemical-Biological Warfare Technology Base

Title: Chemical Munitions and Chemical Combat Support
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3582	3220	5231	4601	Continuing	Not Applicable
A554	Chemical Munitions and Chemical Combat Support	3582	3220	5231	4601	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Union of Soviet Socialist Republics (USSR) has developed and continues to improve upon its formidable chemical warfare capabilities. These capabilities represent a threat to the survival of US (and North Atlantic Treaty Organization (NATO)) Forces. The US needs a program to counter (deter) that threat by exploitation of state-of-the-art concepts and creation of a broad technology base to support development of a selective chemical response capability. This project supports that need by providing for the technology base to support chemical munitions (binary lethal and incapacitating) and chemical combat support materiel (flame, smoke, incendiary and civil disturbance/tactical irritant) development. Specifically, this project applies the results of basic research to the exploratory development of previously mentioned chemical munitions and chemical combat support weapon systems in meeting stated Army requirements. Additionally, the Army has been designated the Executive Agent for RDTE of chemical weapons and chemical-biological defense for the Department of Defense (DoD). As such, there is a need for a project to support DoD-wide requirements in chemical weapon systems development. This project provides for such support.

C. BASIS FOR FY 1979 RDTE REQUEST: To provide technical support to munitions development to assure the most efficient/least risk munition development; determine scale-up to munition parameters for selected intermediate volatility or highly persistent agents for weaponization purpose; complete exploratory development of extended range projectiles and light weight mobile systems; continue investigation of concepts for bulk mixing techniques, modular munitions and land mines; continue evaluation of potential new binary agents; devise practical methods for field assessment of simulants and develop analytical quality control standards for new binary chemical intermediates; and determine the long-term stability and compatibility of new binary chemical intermediates for munitions design and shelf-life purposes.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.26.22.A
DoD Mission Area: #135 - Chemical-Biological Warfare Technology Base

Title: Chemical Munitions and Chemical Combat Support
Budget Activity: #1 - Technology Base

E. DETAILED BACKGROUND AND DESCRIPTION: This program element supports the entire Department of Defense (DoD) chemical technology base on which development of deterrent/retaliatory and combat support chemical weapons depends. It addresses in-depth exploratory investigations in the following areas: (1) Lethal Chemical Agents/Weapons: Encompasses applied research activities associated with physical and analytical chemistry of potential lethal chemical systems; exploratory development of binary lethal chemical agents of various degrees of volatility to be used with a variety of munitions types with a resultant capability for air or ground delivery using standard and advanced weapons systems; and applied research leading to an understanding of phenomena which enhance the threat and effectiveness of these agents; (2) Incapacitating Chemical Agents/Weapons: Includes searches for new, more potent, shorter onset time, shorter effects duration, percutaneously active, and very safe to handle incapacitants; developing effective means for exploitation of these agents; and identifying the physical and chemical characteristics of these agents; (3) Chemical Combat Support Systems: Includes accelerated search for improved multi-spectral smoke/aerosol screening materials and delivery systems to cover visual through microwave regions of the electromagnetic spectrum; and provides for large area screening capability with minimum logistics burden. Also included are the development and evaluation of new chemical compounds for riot control agents, flame and incendiary materials, development of concepts for their use and the establishment of feasibility of munitions responsive to the concepts. This effort originally consisted of 6.26.19.A, Chemical Combat Support and 6.26.20.A, Chemical Munitions Technology. These efforts were incorporated into 6.26.22 (single program element funding).

F. RELATED ACTIVITIES: Investigations under this project provide the essential exploratory effort in lethal, incapacitating, and riot control agents and munitions and the total technology base for the entire Department of Defense; no comparable work is done by the other Services, and coordination is maintained with them to assure provision of the technology essential to their development needs. Close coordination is maintained between the investigative groups to preclude duplicative effort through joint working and coordinating groups. Coordination and cooperation is maintained with the United Kingdom (UK), Canada, and Australia. Related technical investigations are conducted under PE 6.27.06, "CB Defense and General Investigations".

G. WORK PERFORMED BY: US Army Chemical Systems Laboratory, Edgewood, MD; University of Oklahoma, Norman, OK; Ivy Research Laboratory, Philadelphia, PA; Georgia Institute of Technology, Atlanta, GA; General Electric Corporation, Pittsfield, MD; Dugway Proving Ground, Dugway, UT; and White Sands Missile Range, White Sands, NM.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Over the past 20 years, virtually no systematic exploratory effort was expended in screening smoke materials. In contrast to this inactivity, a variety of flame and incendiary, lethal chemical, and riot control agent (RCA) munitions systems have been developed and fielded. Two incapacitating agent munitions were developed and fielded. In

Program Element: #6.26.22.A
DoD Mission Area: #135 - Chemical-Biological Warfare Technology Base

Title: Chemical Munitions and Chemical Combat Support
Budget Activity: #1 - Technology Base

the late 1960's, the binary concept, to enhance safety and security in the field, has been applied successfully to development of artillery chemical projectiles. Searches for an intermediate volatility agent using the binary concept are now being conducted. In the incapacitating agents and weapons area, a compound (EA3834) which is quick acting at low concentrations has been found. Based on assessment of the expected threat, a high urgency was placed on development of new multi-spectral large area smoke/aerosol screening agents. In 1976 and 1977, a five-year program for this purpose was prepared and initiated. Test facilities were modified to enable measurement of screening characteristics of standard and new screening agents. All US standard smokes were characterized and tests of promising new materials for infrared screening were begun. New techniques for area screening and rapid dissemination started. Several unique foreign smoke formulations have been evaluated. Feasibility studies of establishing a computerized smoke technical data bank were completed. Work was started to measure the refractive index of known smoke ingredients. In FY 1977, the following accomplishments were made: synthesized and evaluated new chemical intermediates for EA5365, and conducted stability studies on neat and stabilized samples as well as mixtures of the proposed intermediates; assessed both insoluble and soluble polymers and conducted field dissemination tests with simulants, which resulted in Polyisobutyl Metacrylate (PIBM) being selected as an additive to the chemical intermediate QL; laboratory tested an alternative dye for large scale munition dissemination firing; conducted area coverage studies; evolved design concepts for application of the binary system to lightweight mobile systems and conducted tests to assess projectile ballistic dynamic stability for various quantities of liquid fills and mixing characteristics in the 8-inch/130 millimeter extended range projectile; fabricated and evaluated two binary lethal agent rocket warhead concepts and determined the toxicities of intravenously administered percutaneous compounds related to EA5365.

2. FY 1978 Program: Complete technological support for XM736 Binary VX projectile; evaluate binary intermediate volatility agent (IVA) data base and recommend agent/munitions combinations for further exploitation; complete thickened binary VX agent studies on clothing penetration and surface persistency; complete initial design studies of cannon-launched, extended-range projectiles and lightweight mobile systems; continue search for new binary lethal agents with greater effectiveness through clothing; develop improved reactive simulants for binary VX and binary IVA of choice; and provide support as needed for evaluation of current US capabilities, including viability of stockpile, to assess the need for new lethal chemical agent munitions.

3. FY 1979 Planned Program: Provide technical support to munitions development; determine scale-up to munition parameters for selected intermediate volatility, or highly persistent agent for weaponization purposes; complete exploratory development of extended range projectiles and lightweight mobile systems; continue investigation of concepts for bulk-mixing techniques, mobile munitions, and land mines; evaluate new drone system as delivery vehicles; continue evaluation of potential new binary agents; devise practical means for field assessment of simulants and develop analytical quality standards for new binary chemical intermediates for better means of munition evaluation and control of starting material; and determine long-term stability and compatibility of new binary chemical intermediates for munitions design and shelf-life estimation. Increase in funding of FY 1979 over FY 1978 is to support increased efforts in smoke toxicology studies relating to development of safer smoke materials.

Program Element: #6.26.22.A
DoD Mission Area: #135 - Chemical-Biological Warfare Technology Base

Title: Chemical Munitions and Chemical Combat Support
Budget Activity: #1 - Technology Base

4. FY 1980 Planned Program: Continue technological support to munitions development; complete scale-up to munition parameters for intermediate volatility agent (IVA) or highly persistent agent; complete exploratory development of modular munitions, land mine, and bulk-mixing techniques; continue evaluation of drone delivery systems; continue evalution of promising new binary agents; continue investigation of practical methods for field assessment of simulants; and complete long-term stability and compatibility studies of new binary chemical intermediates.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.01.A
DoD Mission Area: #126 - Communications

Title: Communications - Electronics
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4675	5698	7257	6950	Continuing	Not Applicable
AH92B1	Automatic Data Processing	1786	2608	3335	2318	Continuing	Not Applicable
AH92C1	Electromagnetic Compatibility Technology	323	300	350	500	Continuing	Not Applicable
AH92F1	Signal Processing Technology	730	875	1425	1732	Continuing	Not Applicable
AH92M1	Multichannel Communication Technology	1816	2455	1975	1800	Continuing	Not Applicable
AH92N1	Net Communication Technology	0	0	0	300	Continuing	Not Applicable
AH92S1	Systems Technology	20	0	0	0	Terminated	Not Applicable
AH92T1	Terminal Devices Technology	0	0	172	300	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The major thrust in the area of automatic data processing (ADP) is to develop and transfer technology advances in computer sciences for near term cost and quality improvements for both Department of Defense (DOD) weapons and ADP systems. This program area is coordinated under the Joint Service R&D Technology Panel to the Office of the Secretary of Defense (OSD) Management Steering Committee for Embedded Computer Resources (MSC-ECR). As such, it is responsive to DOD-wide deficiencies, including an absence of standardized computer architectures and languages, resulting in excessive automated system development and maintenance costs. The program focuses specifically on the provision of common software tools to enhance programmer efficiency, and the establishment of standardized advanced computer architecture, equipments, and programing languages. This program also supports development of the communications-electronics technology base required to meet the mission needs of the next generation of tactical communications systems. The problems which limit the capabilities of current communications equipment to be solved include excessive weight, size, power drain, crosstalk, Electromagnetic Pulse and Electronic Countermeasures threat, reliability, and low channel capacity. The present system of metallic wire line communications requires cost, bulky inventories of coaxial and multi-pair cables which can be overcome through replacement by fiber optics communications systems. Catastrophic microwave component failures can be overcome by development of a phased array antenna amplifier system with integral redundancy. Army does not have a digital distribution system to accommodate fire control and command and control system data exchange.

C. BASIS FOR FY 1979 RDTE REQUEST: Major contractual effort will exploit recent technical advances in fiber optics. Support the development of the Army Tactical Information Distribution System by use of packet radio and associated signal processing technology. Support the electromagnetic interference reduction effort in order to keep pace with new and advanced communication systems. The Automatic Data Processing (ADP) task is part of the joint R&D program to overcome deficiencies identified

in the Defense System Software Research and Development Technology Plan. A primary FY 79 thrust is to accelerate the use, by Prog am Managers and other Automatic Data Processing (ADP) application system developers, of new software and hardware advances. Emphasis will be on product planning for the software compatible family of military computers, collection and analysis of an integrated system of higher order language and support software tools in a test bed environment.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Technical areas: Automatic Data Processing Technology--develop and apply improved technologies/methods to support future tactical computer systems; Electromagnetic Compatibility--develop technologies applicable to electromagnetic compatibility and interference so as to avoid problems by proper design, rather than after the fact remedial measures (includes design standards and measurement/instrument techniques); Signal Processing Technology--state-of-the-art improvement in processing and transmission of data and voice to achieve increased channel capacity, reduced digital error rate, timely tactical information distribution, greater reliability, and reduced vulnerability of enemy intercept; Multichannel Communication Technology--develop new multichannel transmission techniques (including optical, millimeter, and microwave methods so as to reduce system size, weight, set-up time and jamming vulnerability with increased reliability, communication range, and information transmission capacity; Systems Technology--apply mathematical, statistical, and other methods to optimize communication system performance on a system-wide basis; Terminal Devices Technology--apply new techniques for the conversion of written, typed, and other graphic information into electrical form for transmission over communication systems (and the converse).

F. RELATED ACTIVITIES: This program provides the exploratory development needed to support the following: Program Element 6.37.07.A, Communications Development; Program Element 6.37.22.A, Tactical Operations System; Program Element 6.37.23.A, Command Control; Program Element 2.80.10.A, Joint Tactical Communications Program, (TRI-TAC); Program Element 6.37.03.A, Automatic Data Processing Equipment Development; Program Element 6.32.07.A, Aviation Electronics (AVIONICS). Other related research and studies performed by the Air Force and Navy are also considered. Coordination is accomplished by reviews conducted by Department of Defense, through the exchange of technical reports and attendance at scientific meetings and conferences. Projects 6.27.25.A 0730 (Improved Data Effectiveness and Availability) and 6.27.25.A 0051 (Telecommunications Software) have been consolidated into task AH9281 of this program.

G. WORK PERFORMED BY: ITT, Nutley, NJ; ITT, Roanoke, VA, GTE Sylvania, Waltham, MA; Hughes Aircraft, Malibu, CA; Harris Corp., Melbourne, FL; ITT, Cannon, MA; Charles Stark Draper Laboratory, Inc., Cambridge, MA; Rand Corp., Santa Monica, CA; OPTELCOM, Gaithersburg, MD; ITEK, Sunnyvale, CA; AIL, Long Island, NY; Softech Inc., Waltham, MA; Signatron, Boston, MA. Contract monitoring and in-house development are accomplished by US Army Communications Research and Development Command, Ft Monmouth, NJ.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Developed a very low power frequency synthesizer to simplify radio tuning and successfully tested new optical communications system techniques; quantified high potential of a low probability of intercept radio

completed the design of a new computer programming language which will be adopted as the Army standard tactical language; developed the framework for a software engineering experiment; completed design of a real-time tactical operating system; successfully evaluated range and intercept improvements achievable by radio frequency energy spreading; completed a modulation code conversion device for testing; developed an experimental forward error correction device for data systems; completed a technical/cost tradeoff analysis which showed the superior advantages of fiber optic and over conventional communication systems; analyzed architecture for a new family of tactical computers; revised for DoD several electromagnetic compatibility standards which will improve equipment design; completed testing of error correcting coder; completed fabrication of end terminal for long haul fiber optic cable system; and fabricated a millimeter wave radio prototype system. On the basis of an Army/Navy review committee, selected a candidate architecture for the software compatible Military Computer Family which will reduce proliferation of computer models and architecture. Established the Telecommunications Design Center, a test bed designed to facilitate emulation of military software systems, performance, monitoring, and interoperability experimentation. Completed design for an automated Electromagnetic Susceptibility Test System that will enable the use of uniform production tests to ensure that new communications-electronics will not be vulnerable to interference from other equipment. Completed definitions and a system of units for the bonding, grounding, and shielding standards. This effort will ensure uniform compliance for new equipment design and installations. Completed fabrication and preliminary testing of a Time Spread Voice System for very high frequency radios which successfully demonstrated the feasibility for the use of low probability of intercept radio. Completed and successfully tested a model of the Long Haul Fiber-Optic cable system. Fabricated a Local Distribution Fiber-Optic Cable System for the AN/TTC-38. Exploratory Developmental Fiber-Optic cable systems were demonstrated and shown to have numerous advantages over copper cable. Some of the important benefits demonstrated for optical fibers are: radio frequency interference immunity; large bandwidth for size and weight; small size and weight-ease of installation and reduced transportation volume; potential low cost; high temperature tolerance and tensil strength; improved reliability and maintainability; and reduced power consumption. Tested Fiber-Optic cable during REFORGER (Germany). The test enabled tactical units to establish communications in less time with a more dependable cable system. Army is now ready for Advanced Development and is confident that Fiber-Optic cable systems will perform as expected.

2. FY 1978 Program: Complete the ITEK contract to develop form fit and function specifications for the internal architecture of the Military Computer Family. Develop plan for Tactical Programing Language and Army Tactical Data Systems software tools and investigate and implement a test method for information distribution via packet switching concepts. Initiate contracts making full use of microprocessors for distributed data processing systems and initiate contract to experiment with battlefield scenarios for a Tactical Information Distribution network. Initiate efforts for use of computer based training/maintenance. Continue work on Electromagnetic Compatibility (EMC) standards and instrumentation, EMC design support, Army frequency allocation processing and interference reduction techniques. Continue Packet Radio/Tactical Information Distribution System testbed support activity. Complete delivery of Fiber-Optic long haul cable system and components for a Fiber-Optic guided missile system. Initiate test of long haul Fiber-Optic system as part of the Digital Group Multiplexer development tests. Fabricate experimental manpack millimeter wave radios. Complete design for the development of a Microwave Integrated Phased Array Antenna Amplifier for Troposcatter.

Program Element: #6.27.01.A
DoD Mission Area: #126 - Communications

Title: Communications-Electronics
Budget Activity: #1 - Technology Base

3. FY 1979 Planned Program: Increase in the FY 79 over the FY 78 level of effort is primarily due to the increased emphasis being placed by the Army and Department of Defense (DOD) on computer sciences. The goal of the Military Computer Family is to obtain a standardized computer architecture that will permit the transfer of previously developed software to new computer systems as technologies change. The objective is to write hardware specifications that permits wide vendor competition, is broadly applicable to a variety of user requirements, and which will permit future hardware technology advances to be incorporated over the computer life cycle. Efforts will be accelerated to standardize control and improve the Military Computer Family (MCF) architecture and to develop specifications for MCF support software unique to a tactical real time environment. Efforts will also be increased in support of the MCF requirement for a standard higher order program of the MCF requirement for a standard higher order programing language (DOD-1); the language structure will be analyzed and plans for early implementation will be accomplished. In support of the tactical Data Distribution System (DDS) effort, the Advanced Research Projects Agency Network (ARPANET) interface with the DDS test bed will be analyzed to determine the nature and specification of software tools necessary to provide the required DDS test bed operational flexibility. Work will be continued on Electromagnetic Compatibility standards, instrumentation, design support, frequency allocation and interference reduction. Complete the equipment complement for the Packet Radio/Tactical Information Distribution System test bed and implement it initially for field artillery and air defense systems. Initiate work on signal conversion concepts involving data modem, error coding and channel simulation techniques. Start contract to optimize system configuration for Fiber Optic intrusion resistant cable, perform test and evaluation of high speed payout Fiber-Optic cable systems and test an exploratory model of air-layable Fiber-Optic cable. A contract will start development of low cost compact millimeter wave repeaters and a millimeter wave binocular radio will be tested. The scale model microwave integrated phased array antenna amplifier will be tested with the AN/GRC-143 radio. Initiate investigation of relevant record communication techniques and/or equipment for copiers, optical character readers, facsimile recorders and scanner, and data compression techniques. Reasons, in addition to the one mentioned in the beginning of this paragraph, for increased FY 79 funding over the FY 78 level are procurements to complete the Packet Radio/Tactical Information Distribution System test bed and the start of work to investigate record communication techniques and equipment.

4. FY 1980 Planned Program: The MCF work and software efforts will continue. Test and evaluation will be performed in a scaled down set of tactical scenarios for intelligent terminals. The Tactical Information Distribution contract will be completed and results analyzed towards satisfying Tactical Information Distribution System requirements. Training efforts will continue. The Electromagnetic Compatibility technology work will continue as previously described. The Packet Radio/Tactical Information Distribution System test bed will be expanded to include interoperability of data systems. Continue support of signal processing technology in areas of encoding devices, data modem techniques, tactical channel simulation and error control coding. The intrusion resistant Fiber-Optic cable and the millimeter wave repeaters will be delivered and tested. A contract will start development of a low cost miniaturized 94 gigahertz radio for short range covert battlefield communications. The Net Communications Technology effort will start with an investigation of bandwidth reduction and efficient radio frequency tuning techniques for future single channel radios. Continue investigations of relevant record communication techniques and/or equipment for copiers, optical character readers, facsimile recorders and scanners, and data conversion techniques.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.03.A
DoD Mission Area: #123 - Search and RSTA

Title: Combat Surveillance, Target Acquisition and Identification
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL PDP PROGRAM ELEMENT	4943	4240	5239	6160	Continuing	Not Applicable
DH93-01	Weapon Location	1206	531	390	675	Continuing	Not Applicable
DH93-02	Personnel & Vehicle Detection	1035	992	1150	1300	Continuing	Not Applicable
DH93-03	Ranging, Designation & Tracking	1403	1063	1000	975	Continuing	Not Applicable
DH93-04	General Laser Technology	543	695	1000	1160	Continuing	Not Applicable
DH93-05	Radiac	90	128	290	200	Continuing	Not Applicable
DH93-06	Identification Friend/Foe	51	77	643	615	Continuing	Not Applicable
DH93-07	Data Transmission	503	754	576	1175	Continuing	Not Applicable
DH93-08	Photographic Techniques	12	0	190	60	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the technology base for new concepts and advanced systems for the solution of presently unsolved surveillance, target acquisition, and identification requirements. These include developing modular radar and laser componentry to reduce size and cost, and increase performance and reliability; non-cooperative battlefield identification friend or foe; radar techniques to identify stationary targets, penetrate foliage, and provide an all-weather capability; and integrating target acquisition sensors to provide a fused intelligence output. It identifies the most promising alternatives to fill existing operational gaps in the Army's integrated surveillance, target acquisition, and identification capability. Exploratory development is performed in the following technological areas: weapons location; personnel and vehicle detection; general laser and radar technology; ranging, designation, and tracking; identification friend or foe (IFF); measurement of nuclear radiation and bursts; data transmission, and photographic techniques.

C. BASIS FOR FY 1979 RDTE REQUEST: Work will be performed on completion of 1-2 micron laser developments and extension of this effort to developments at other wavelengths; laser devices for advanced fiber optics communications systems; second generations beacon/beamrider guidance components; noncooperative Battlefield IFF; laser radar/radar hybrids; the Target Effluent Detection System; and exploration of submillimeter wavelength technology applied to multifunctional engagement systems for surveillance, target acquisition, and weapons delivery. Continue work on the Surveillance and Target Acquisition Radar for Tank Location and Engagement (STARTLE). This radar will be installed on the Army's main battle tank for target location and engagement under poor visibility conditions. Initiate work to demonstrate the feasibility of installing a radar on top of a helicopter rotor. This

will enable the helicopter to search for targets without exposure to enemy fire. Initiate work on low cost, highly reliable radar components, such as low cost octave bandwidth antenna module (X to Ku band), modular charge coupled device signal processor, octave bandwidth tunable (X to Ku band) all solid state receiver/transmitter module. Continue efforts on techniques to detect stationary targets. Test prototype radiation dosimeters and radiacmeters.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This project funds the exploratory development performed by the Combat Surveillance and Target Acquisition (CSTA) Laboratory. Major areas of emphasis are the development of multifunctional laser systems and laser wavelength diversification leading to universal, common laser modules; weapons location techniques with emphasis on a fixed target radar and airborne and ground based flash detection systems; improved surveillance radars; development of a family of radiological detection and measuring equipments; development of small-format tactical photo equipments and of photo processing and exploiting equipments; and air-to-ground data transmission systems. This project also addresses improvements to current systems; for example, an investigation of techniques for hardening radar antennas, and the use of low cost, expendable cartridges in laser rangefinders as well as the development of a radar to enable the Army's main battle tank to engage targets under conditions of poor visibility.

F. RELATED ACTIVITIES: Related development is performed by the Navy and Air Force. Work is coordinated during reviews conducted by the Office of the Under Secretary of Defense for Research and Engineering through technical reports, inter-laboratory visits and communications, attendance at specialized scientific meetings and conferences, inter-Service liaison, the annual and the biennial Department of Defense Laser Conference, the Annual Tri-Service Radar Symposium. Additionally, the Army and the Defense Advanced Research Projects Agency (DARPA) are participating in a joint program to find new or improved solutions in the hostile weapons location and radar integration areas.

G. WORK PERFORMED BY: In-house work is performed by the US Army Electronics Research and Development Command (ERADCOM), Fort Monmouth, NJ. Contractors include Honeywell Incorporated, Minneapolis, MN; RCA, Burlington, MA; Block Engineering, Cambridge, MA; Santa Barbara Research Center, Santa Barbara, CA; Raytheon, Boston, MA; Pacific Sierra, Santa Monica, CA; Laser Diodes, Metuchen, NJ; Science Applications Incorporated, Jolla, CA; Hughes Aircraft, Culver City, CA; Rockwell International, Anaheim, CA; and United Aircraft, Norwalk, CT.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Prior technological efforts have resulted in type classification and procurement of the AN/PPS-5, AN/PPS-15, AN/TPQ-36, and AN/TPQ-37 radars, the AN/GVS-5 Laser Rangefinder, and the AN/PAQ-1 Laser Target Designator; and full scale development of the AN/PAQ-3 Modular Universal Laser Equipment and AN/AAS-32 Airborne Laser Tracker. The design and exploratory development of a miniaturized, low cost, short range Mini-Rangfinder has also been completed. Applications of modular laser component technology include the tank rangefinder, remotely piloted vehicle rangefinder/designator, and eye-safe training

aids. During FY 1977, work continued on laser technology addressing wavelength diversity and multifunctionally leading to advanced concept, high performance, low cost systems. Work continued on development of laser sources and receivers for advanced concept fiber optics communications systems, with emphasis directed toward development of second generation laser systems to satisfy mid and long term Army needs for improved performance in degraded environments. Significant progress was made toward defining a Passive Artillery Locating System. Research effort was initiated to develop submillimeter technology for realizing efficient and practical all-weather advanced systems. Radar processor designs and prototype development, using charge-coupled devices have been initiated. Test and evaluation of a prototype foliage penetration radar were successfully completed. Complete hardware fabrication and extended software applications of the Environment and Radar Operational Simulator (EROS). EROS will simulate the environmental inputs and signal processor parameters of surveillance radars. Proposals for the Surveillance and Target Acquisition Radar for Tank Location and Engagement (STARTLE) feasibility models were evaluated. Promising target signature analysis techniques for detection of tactical targets in ground clutter have been developed. Developed prototype silicon diode neutron dosimeter electronic readout system, first generation digital radiacmeter, and prototype gamma dosimeter for the Miniature Multipurpose Radiac Device.

2. FY 1978 Program: Application of modular laser component technology for providing significantly lower cost second generation Army systems will be actively pursued and extended to other Services. Continue technical support for ongoing developmental laser systems. Fiber optic technology development will be hardened for fieldable communications systems. Further develop laser wavelength diversity and multifunctionality technology. An initial prototype model Battlefield Identification Friend or Foe will be completed, tested, and evaluated. Continue efforts on developing laser radar/radar hybrids to take advantage of the excellent scanning properties of radars and the precision target location and weapons delivery capabilities of lasers. Continue efforts on the Target Effluent Detection System. Complete the Position and Attitude Monitor effort, and initiate plans for integration in a mini-balloon/German KIEBITZ for advanced surveillance systems applications. Complete efforts on the Environment and Radar Operational Simulator and charge coupled devices. Monitor Surveillance and Target Acquisition Radar for Tank Location and Engagement (STARTLE) contracts, and evaluate first phase study results prior to starting the initial prototype phase. The Anti-Armor Surveillance and Target Acquisition Radar (ASTAR) exploratory development model will be demonstrated with a millimeter wave beamrider system to define system performance and interface requirements. Continue testing of prototype digital radiacmeter. Continue the target signature analysis to provide techniques for classification of tactical ground targets using signature information.

3. FY 1979 Planned Program: Continue technological support of ongoing developmental programs. Complete technology transfer of long-life injection laser/advanced detection modules to first generation fiber optics communications systems. Initiate advanced technology research effort in this area. Continue laser wavelength diversity common module efforts. Continue efforts on laser beamrider/beacon module for advanced guidance systems. Universal Tracker developmental hardware will be tested and potential as radar adjunct established. Exploration of the technology base for developing a non-cooperative Battlefield Identification Friend or Foe (IFF) will be continued. Laser radar/radar hybrid efforts will continue. Complete and test developmental Target Effluent Detection System. Initiate effort to develop electro-optical heterodyne/homodyne base technology for surveillance, target

acquisition and weapons delivery. Continue efforts on Surveillance and Target Acquisition Radar for Tank Location and Engagement (STARTLE) and Anti-Armor Surveillance and Target Acquisition Radar (ASTAR). Modular radar component development will begin with signal processor development. Complete the development of target classification techniques and demonstrate their effectiveness. Test prototype gamma dosimeter. Develop various mixes of glass for gamma dosimeter. Develop prototype Charge Transport dosimeter and Cadmium Telluride crystals for test. The increase in FY 1979 is due to increased effort in general laser technology and Identification Friend or Foe (IFF). A total of 27 professional and 7 support personnel are involved in this program element.

4. FY 1980 Planned Program: Continuation of FY 1979 program. Complete contractual efforts and on-going tests on the non-cooperative battle identification friend/foe (BIFF) development, and the modular multipurpose data link. New efforts will be initiated in general laser technology to find innovative approaches for extending laser usefulness, and to design a thermal imaging/laser hybrid target acquisition/designation for new, smaller weapons systems.

5. Program to Completion: This is a continuing program.

FY 1979 RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.04.A
DoD Mission Area: #133-Environmental Quality Research and Development

Title: Military Environmental Criteria Development
Budget Activity: #1-Technology Base

A. RESOURCE (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL PROGRAM ELEMENT	2850	3040	3307	3600	Continuing	Not Applicable
AF25-01	Analytical Systems Technology	710	804	192	160	Continuing	Not Applicable
AF25-02	Standards Development	1050	910	1360	1260	Continuing	Not Applicable
AF25-03	Decontamination Technology	1090	1326	1755	2180	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program was established in FY 1977 to provide technology development support to the mission of the Project Manager for Chemical Demilitarization and Installation Restoration. The current program priority is in support of prevention of contaminant migration from Rocky Mountain Arsenal (RMA), Denver, CO. The technical thrusts of the program are: development of analytical techniques for identification and quantification of contaminants; research to characterize contaminants and determine their toxicities for establishment of standards by regulatory agencies; and development of containment/decontamination technology to meet established standards. Technology developments will support containment/decontamination efforts at other Department of Defense installations as problems are identified and plans are approved.

C. BASIS FOR FY 1979 RTD&E REQUEST: To continue efforts to improve analytical methodology for application at RMA and for other restoration projects that are approved by Department of the Army; to complete feasiblity studies for containment of pollution sources and to evaluate alternative methods for source elimination; to establish design criteria for an expanded RMA boundary water treatment system to comply with the State of Colorado's cease and desist orders.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Increasing public and national interest in the environment, coupled with the progressive encroachment of civilian communities to the borders of previously isolated Army installations, have created growing concern about the potential threat posed by the steady movement of groundwater contaminants to the borders of the installations. As the result of military, Congressional and public interest in such contamination at RMA, direction was

provided by the Assistant Secretary of the Army for Installations, Logistics and Financial Management (ASA(I,L&FM)) to establish a comprehensive program of rectification for the total Army problem. Responsibility for this program was assigned to the Project Manager for Chemical Demilitarization and Installation Restoration (PMCDIR) and a charter approved by the Secretary of the Army on 29 Apr 77. An overall plan of approach to the problem was developed by PMCDIR, which includes three principal phases: Installation Assessment, Systems Development and Decontamination Operations. The RDTE funded part of this plan applies only to the technology effort within the Systems Development phase. Other phases of the plan will be accomplished with Operation and Maintenace, Army (OMA) and Military Construction, Army (MCA) appropriations. The Systems Development phase consists of three technical areas: Analytical Systems Technology, Standards Development (establishment of environmentally acceptable levels of tolerance for each contaminant), and Decontamination Technology. A detailed plan for addressing contamination problems at Rocky Mountain Arsenal (RMA) was established and work is in progress.

F. RELATED ACTIVITIES: The conduct of the Installation Restoration (IR) program involoves extensive interface with a significant number of other Government agencies. These include, but may not be limited to, Departments of State; Health, Education and Welfare; Agriculture; Transportation; Interior; US Nuclear Regulatory Commission; Environmental Protection Agency; National Academy of Sciences; Department of Defense (DoD) Explosive Safety Board; and state and local governments. On 23 July 1976, the Department of the Army was designated as the lead service for the compilation and refinement of applicable technology and the development of new or improved technology and criteria or standards for the DoD installation restoration program as it relates to all contamination, including chemical, biological and radiological. This assignment was delegated to the PMCDIR. A concept plan has been developed for the coordination of the required effort between the Army, Navy and Air Force.

G. WORK PERFORMED BY: In FY 1979, approximately 41 percent of the RDTE program dollars will be assigned to the Army Surgeon General (TSG) for toxicological testing of chemical contaminants leading to the establishment of standards; approximately 6 percent of the dollars will be assigned to Chemical Systems Laboratory, US Army Armament Research and Development Command, Edgewood, MD, primarily to assist in developing advanced techniques for sampling, analyzing, handling and storage of contaminated samples. The balance of the RDTE program resources (53 percent) will be used primarily for development of decontamination process technology, in support of RMA. It is estimated that approximately 51 percent of the total program in FY 1979 will be in contracts, 5 percent will be assigned to Government agencies outside the Army, and 44 percent will be used for in-house effort.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: This program was established in FY 1977. A detailed plan for control of off-post migration of chemical pollutants at RMA was prepared. An Analytical Systems Working Group, composed of chemists from other Army agencies, was established to recommend analytical schemes, a Quality Contol Plan (QCP) and required analytical instrumentation. The effort by the Army Surgeon General to develop data needed to recommend environmental

standards included evaluation of 22 top priority compounds. The Surgeon General's coring and analysis program involved the taking of 500 soil and 50 vegetation samples, and was completed in FY 1976. Toxicology studies include mammalian, aquatic, wildlife and vegetative toxicity studies with this work being performed by the Army Surgeon General's contractors. Acute and subacute toxicity studies on Diisopropylmethyl Phosphonate (DIMP) and Dicyclopentadine (DCPD) were completed and chronic toxicity studies were continued. The Surgeon General recommended temporary guidelines for DIMP and DCPD to the National Research Council in August 1976. Design criteria were established for an interim groundwater containment/treatment system for Rocky Mountain Arsenal (RMA), consisting of dewatering wells, Bentonite barrier, a granular carbon absorption water treatment facility and a series of recharge wells. Laboratory and field studies indicate that such a system will reduce DIMP, DCPD and sulphur compounds to trace quantities. In FY 1977 analytical methods for five RMA groundwater contaminants were developed and automated in the Quality Control Program. Temporary environmental guidelines for concentrations of DIMP and Diisopropylmethyl Phosphonate (DIMP) and Dicyclopentadine (DCPD) in drinking water based on toxicology testing were concurred in by the National Research Council. Laboratory and bench scale water treatment studies led to the selection of a granular carbon adsorption system to treat groundwater at the north boundary of RMA.

2. FY 1978 Program: The following actions are being accomplished in support of the RMA Program: In the Standards Development task, a third problem definition study on 13 additional contaminants found in RMA waters is being completed and recommendations for any additional toxicology studies will be made by August 1978. The DIMP/DCPD chronic toxicity studies are continuing with a recommendation for final standards scheduled for November 1978. The acute and subacute toxicology studies on three sulphur compounds are to be completed in July 1978 and temporary guidelines for these compounds recommended. Development of analytical methods in support of the comprehensive survey sampling and analysis work are being continued. Soil, water and tissue analyical methods will be selected and implemented by January 1978. The North Boundary pilot containment/treatment system is being installed; operations are scheduled to commence by May 1978. These operations will support development of design criteria for an expanded system, if required, to fully satisfy the State of Colorado cease and desist orders. In the area of source containment, feasiblity studies to contain Basins F and A at RMA have been initiated. A system will be selected by May 1978 to enable submission of the necessary Military Construction Army projects. Water treatment studies are being continued involving both organic and inorganic removal techniques. Granular carbon absorption and ultra violet-ozonolysis processes are being tested using waters both at the boundary and sources. The inorganic treatment focuses on fluoride removal and selection of a process in support of the pilot containment/treatment system will be made by January 1978. Source treatment studies are limited to small laboratory scale characterization of Basin F contents as a prelude to bench scale treatment work.

3. FY 1979 Planned Program: Support of the RMA and other Department of the Army (DA) approved projects will include work in all three major technical areas. Analytical Methods Development in support of the RMA project will include finalization and publication of analytical methods developed in FY 1978. In the Standards Development area, final environmental guidelines will be recommended for DIMP and DCPD. Toxicity studies will also be initiated on an estimated

three chemical contaminants as a result of the Third Problem Definition Study conducted in FY 1978. In the Decontamination Technology area, design criteria for an expanded Boundary Water Containment/Treatment System will be developed. This system, when operational, will fully satisfy the State of Colorado's cease and desist orders. Combination pilot testing of inorganic and organic water and soil treatment processes to treat contamination sources will be initiated. Containment feasibility studies for sources at Rocky Mountain Arsenal (RMA) will be completed and a decision made to contain, treat or pursue a combination of source elimination alternatives. The $267,000 increase in FY 1979 over FY 1978 supports increased efforts in development of decontamination technology. In connection with future Army DA approved projects, specific unit processes and operation for removal and destruction of classes of pollutants will be evaluated. The operations would include liquid extraction, adsorption, thin film separation and leaching equipment, along with process equipment for aeration, oxidation, ozonolysis and chlorinolysis systems.

4. FY 1980 Planned Program: Support of the RMA project will include work in all three major technical areas. In the Analytical Technology Development Area, research will be conducted to improve and further automate the analytical methods in support of the survey work. In the Standards Development area, temporary environmental guidelines will be recommended by the Army Surgeon General for the three chemicals for which studies were initiated in FY 1979 and final standards will be recommended for the sulphur compounds. In the Decontamination Technology area, the expanded boundary treatment system will be installed and operated to satisfy the state of Colorado's cease and desist orders. RDTE support will be concentrated on pilot testing of process improvement techniques. Design criteria for the containment/treatment of sources of groundwater contamination will be developed. Elimination of the sources is required to preclude extended operation of the boundary containment/treatment system. In connection with future Department of the Army (DA) approved projects, specific unit processes and operations for removal and destruction of classes of pollutants will continue to be evaluated. The operations would include liquid extraction, adsorption, thin film separation and leaching equipment along with process equipment for aeration, ultra violet-ozonolysis and chlorinolysis system. Bench scale investigations using incineration equipment, evaporation and solar heaters to evaluate techniques for bulk reductions and thermo-destruction of contaminated streams will be conducted.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.05.A
Sub/Mission Area: #121 - Electron Devices

Title: Electronics and Electron Devices
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	10945	12200	13670	16026	Continuing	Not Applicable
AH94 01	Integrated Electronics						
AH94 12	Integrated Assemblies	1455	1830	1670	2000	Continuing	Not Applicable
AH94 13	Integrated Circuits	1082	1960	1510	1800	Continuing	Not Applicable
AH94 02	Microwave Semiconductor Devices & Circuits	1469	1821	2285	2800	Continuing	Not Applicable
AH94 03	Reliability	1154	889	1090	1200	Continuing	Not Applicable
AH94 04	Displays & Peripherals	439	595	690	760	Continuing	Not Applicable
AH94 05	Electron Tube Techniques & Circuits	1159	1320	1320	1400	Continuing	Not Applicable
AH94 06	Microwave Tubes & Subsystems	692	330	1025	1280	Continuing	Not Applicable
AH94 07	Frequency Control	801	733	1120	1300	Continuing	Not Applicable
AH94 08	Microwave Transmission & Acoustic Devices	743	969	1015	1100	Continuing	Not Applicable
AH94 09	Wire & Cable	632	600	635	770	Continuing	Not Applicable
AH94 10	Test, Measurement, and Diagnostic Equipment	318	0	0	0	Not Applicable	Not Applicable
AH94 11	Power Sources & Systems	1001	1153	1310	1616	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This exploratory development program in electronic devices and related materials technologies is resolving critical component barrier problems which are preventing performance, cost, size, weight and reliability improvements in Army electronic equipments to meet specific enemy threats. The objective of this program is to provide performance feasibility of new device concepts and furnish systems designers with the related design guidance and risk assessment with which to configure improved electronic systems. The program represents the Army's prime source of funds required to solve critical component deficiencies in combat equipment/systems. The program encompasses the development of the basic building blocks of all electronic equipment/systems including integrated circuits, solid state devices, microwave tubes, power supplies, frequency control, display devices, and the development of electronic materials and processing innovations.

Program Element: #6.27.05.A
DoD Mission Area: #121 - Electron Devices

Title: Electronics and Electron Devices
Budget Activity: #1 - Technology Base

C. BASIS FOR FY 1979 RDTE REQUEST: The program will continue to develop military types of ultra-high speed, large scale integrated circuits to effect 10-100 times improvement in cost and speed of low power digital electronics for: secure command and control in an expected intense electronic warfare environment; hostile weapons location; and tactical signal analysis to determine nature and deployment of adversary forces. Microwave solid state device development will be continued to permit all types of communications to function in jamming environments, and radical new forms of microwave power tubes will reduce costs and improve efficiency beyond levels which now severely limit the development of stand-off and expendable jammers and airborne platform weapons location systems. Particular effort is required to develop low cost millimeter wave radio frequency components for radars and target designator to "see and strike" through smoke and adverse weather. Millimeter devices are also needed for short range, secure, highly mobile battlefield communications and broadband electronic warfare receivers and jammers. Techniques will be pursued to produce, store, and deliver large packets of energy for laser weapons. Effort will continue on devices to link the battlefield commander in real time to the tactical situation via high contrast, electroluminescent displays applicable to constrained spaces for mobile fire control. Safety features of the new lithium battery systems will be improved to provide a compact, reliable high energy portable source for combat operations over a wide temperature range. Also, thermoelectric generators will be developed for silent, maintenance-free operation (for Aircraft Beacons), and an advanced high precision, lightweight alternating current-to-direct current power supply will be completed for use with critical digital equipment systems. Effort on lightweight, rugged fiber optic cable techniques will be continued to further improve Army tactical mobility and data capacity and to reduce vulnerability.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This program represents the Army's prime source of funds for solving critical electronic component deficiencies in combat equipment/systems. It provides the technological base in electron devices and represents the future strength of the Army for developing new and improved electronic systems required to maintain the technological superiority of our forces. This program is important to the nation, not only for its contribution to the national defense but also for its contribution to the commercial applications of the derived technology. Specifically, the program encompasses the development of the basic building blocks of all electronic equipment/systems including integrated circuits, solid state devices, microwave tubes, power supplies, frequency control, display devices, and the development of electronic materials and processing innovations. Development is based on devices for the Army that are economical to produce, durable and simple to operate, adjust, and maintain. The program objective is to establish cost and performance feasibility of new device concepts by extension of the state of the art to form a basis for advanced system development and better reliability. Device feasibility thereby established is basic to orderly development planning and the expanded technology base provides systems designers with the necessary new technical guidance and risk assessments to configure improved electronic systems for minimum total life cycle cost of ownership. Such coupling is provided for specific system needs in the application areas of electronic warfare, night vision, communications, avionics, data processing, combat surveillance and target acquisition, guidance and fire control, navigation and position location, and missile technology.

Program Element: #6.27.05.A
DoD Mission Area: #121 - Electron Devices

Title: Electronics and Electron Devices
Budget Activity: #1 - Technology Base

F. RELATED ACTIVITIES: Coordination is achieved with other Government agencies through the Department of Defense Advisory Group on Electron Devices and the Inter-agecy Advanced Power Group. Inter-service coordination and program cooperation are also directly derived from joint preparation of the Technology Coordinating Paper on Electron Devices, which assesses the technical program, goals, and potential pay-off from the tri-Service total investment of electronics technology base funds. This program provides the exploratory development for Program Element 6.37.42.A (Advanced Electronic Devices).

G. WORK PERFORMED BY: The US Army Electronics Research and Development Command, Fort Monmouth, NJ. This command is scheduled to use approximately 50 percent of the program funds contractually. The principal contractors are: P. R. Mallory, Burlington, MA; Watkins-Johnson, Palo Alto, CA; RCA, Burlington, MA; Somerville, Camden, and Princeton, NJ; Power Conversion, Inc., Mt. Vernon, NY; TRW, Redondo Beach, CA; Hughes, Fullerton, and Torrance, CA; Northrop, Des Plaines, IL; EG&G, Salem, MA; Varian, Beverely, MA; Raytheon, Waltham, MA; E-Systems, Falls Church, VA; Stanford, Menlo Park, CA; General Electric, Syracuse and Schenectady, NY; Rockwell International, Anaheim, CA; Westinghouse, Baltimore, MD, and Texas Instruments, Dallas, TX.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Microelectronic Devices - Developed very high speed/low power, large scale integrated circuit digital processors to substantially upgrade the Army's capability in real time radar weapons location and reverse the trend toward obsolescence of dated U. S. tactical signal intelligence systems against enemy emitters. Developed high quality hybrid microcircuits for artillery delivered sensors and radar jammers. Microwave/Millimeter Wave Devices - Fabricated first-of-a-kind, low cost, small size 60 gigahertz millimeter wave integrated circuit transmitter/receiver for communications, radar, terminal homing and electronic countermeasures applications. Significantly advanced a new electron tube technology which will reflect a 20X cost reduction of high efficiency devices for Electronic Warfare jammers (aircraft survivability). Developed a compact, lightweight high power modulator component which reduces the size and weight of brassboard pulsers by a factor of 9 for high energy lasers for Air Defense Systems. Passive Devices - Developed improved display panels for command, control and communications equipment, surveillance radars, Electronic Warfare systems and weapon systems that form part of the interoperable battlefield equipment concept. Designed a one cubic inch tactical miniature crystal oscillator having a 16:1 advantage in size and power consumption over conventional designs for Global Positioning System manpack equipment. Developed ceramic 20 megahertz flatpack crystal units for remote battlefield surveillance equipment (REMBASS) and developed an improved frequency selective ferrite limiter to protect the front-end of radio receiver AN/GRC-144 against high signal damage. Power-Sources - Developed a high performance lithium primary battery for portable communications-electronics equipment with at least twice the service life of conventional batteries of issue and capable of performing at extremely low temperatures. Developed new separators for nickel-cadmium aircraft batteries which effectively eliminated prior problems of "thermal runaway" and short lifetime.

Program Element: #6.27.05.A
DoD Mission Area: #121 - Electron Devices

Title: Electronics and Electron Devices
Budget Activity: #1 - Technology Base

2. FY 1978 Program: Microelectronic Devices - This continues the second year of a four-year program to develop critical microfabrication technology and high speed Complementary Metallic Oxide/Silicon on Sapphire and Gallium Arsenide required for real time tactical Signal Intelligence and Electronic Intelligence information processing, net radio and data link anti-jam transmission and secure communications. This is the only viable approach to locating, identifying and neutralizing the large number of sophisticated Soviet emitters expected by 1982. Microwave/Millimeter Wave Devices - Will develop components, devices, integrated circuits and microwave transmitters at 95 gigahertz to provide battlefield surveillance, target acquisition and tracking radar capability in the presence of smoke, dust and adverse weather conditions. The devices will be used to decrease pay loads for Remotely Piloted Vehicles and decrease task silhouettes. Development of a compact brassboard high power modulator will be completed and evaluated in a high energy laser system. Low cost microwave power and electron beam semiconductor tubes will be developed for Electronic Warfare jammers. Passive Devices - Will develop high stability crystal units essential for Global Positioning System manpack receivers and other mobile units in addition to a 1 cubic inch, 250 milliwatt temperature-compensated, voltage controlled oscillator for narrowband sensor systems capable of surviving artillery launch and high shock terminal delivery with minimal frequency changes. High contrast cathode-ray-tubes and flat panel displays will be developed to meet critical viewability requirements under extremely high and low ambient light conditions in combat operations with additional marked improvements in ruggedness and reliability. Power Sources - Will extend performance of the new lithium-sulfur dioxide primary cell to higher discharge rates so that it can be used in night sights, range finders, and other communications-electronic equipment that heretofore had to use heavier and bulky secondary batteries which require ancillary recharging equipment. Small, lightweight advanced power processors for alternating current-to-direct current conversion will be designed (40 percent saving in size and weight); these are critically needed by systems to provide precise, regulated power for major digital equipment installations such as Joint Tactical Communications (TRI-TAC) Program.

3. FY 1979 Planned Program: Microelectronic Devices - The program to obtain faster digital Large Scale Integration signal processing speeds will be accelerated toward providing vastly more powerful Signal Intelligence and real time weapons location in lightweight, low power packages for ground mobile, Remotely Piloted Vehicle and conventional airborne platforms and to provide non-jammable surveillance and target acquisition data links. Specific component technologies to be developed include micro-fabrication to micron-geometry levels and use of gallium arsenide and Charge Coupled Device techniques to achieve multi-gigahertz high density, low power integrated circuits. Microwave/Millimeter Wave Devices - Development will continue on 35-95-140 gigahertz devices for antitank, mini-Remotely Piloted Vehicles radars, smart projectiles, guided missiles, beam riders, secure communications and air defense systems--all having a smoke penetration and all-weather requirements. Needs include higher power, solid state oscillator sources, low noise mixers, low cost intergrated circuit receivers, beam-steering antennas, and high energy pulsers. Low cost power tube technology will be transferred to production development for low cost airborne jammers. Passive Devices - Development will be continue on both surface acoustic wave and quartz crystal frequency synthesizers and precision crystal units for covert, jam-resistant communication and data links. Surface acoustic wave programmable adaptive signal correlator and frequency synthesizer development will continue for real time generalized waveform processing with a goal of a 10X reduction in cost over present techniques. Techniques will be explored to allow a tactical field operator to interact directly with the information presented on his display, thus eliminating several sources of operator error and significantly reducing his training time. Power Sources - The lithium-thionyl chloride electrochemical system with its potential for increasing the energy output of lithium primary cells by a factor of at least 50 percent will permit size and weight reductions essential for forward area man-pack

applications. An advanced thermoelectric generator will be designed giving silent operation, multi-fuel capability, a 50 percent reduction in fuel consumption, and a 70 percent reduction in infrared signature--critically needed to satisfy Army requirements for silent, low maintenance, portable power sources for forward area equipments. Increase in FY 1979 request is due to increased contractual effort.

4. FY 1980 Planned Program: Microelectronic Devices - A significant increase in gallium arsenide digital circuit technology development will be applied to high speed planar large scale integrated circuits to demonstrate results in specific electronic function needs of systems. In particular, a number of such subsystems will be implemented in Electronic Warfare, Signal Intelligence, and Electronic Intelligence real time signal processing applications. Emphasis will be placed on a single semiconductor chip subsystem approach to use of charge coupled devices for data sampling and signal processing, incorporating digital and analog interface circuitry for specialized Electronic Warfare, surveillance, avionics and communication systems. The optimum speed capabilities of second generation silicon-on-sapphire technology (300 to 500 megahertz) will be achieved and technology in sapphire fabrication advanced to elevate complementary metallic oxide semiconductor/silicon-on-sapphire to a mainstream cost competitive position. Large area hybrid microcircuit packages suitable for interconnecting large scale integrated chips without loss of speed will be developed which will be reliable under all military environments; investigations will continue to devise low cost encapsulation techniques for hybrids. Microwave/Millimeter Wave Devices - First generation 95 gigahertz systems will be completed and the efforts will be expanded to extend the frequency range up to 400 gigahertz for such applications as higher accuracy terminal homing for missiles and projectiles; solid-state sources up to 500 gigahertz will be developed concurrently with low noise mixers and applicable integrated circuits. Beam scanning devices to replace phased array antennas will be developed. Millimeter-wave imaging will be explored for smoke penetration. Microwave tube developments will aim at meeting updated radar, electronic warfare and communication requirements (e.g., imaging and foliage penetration radar systems, multi-octave airborne Electronic Warfare jammers, and secure communication systems). Microwave and infrared decoy sources will be developed to protect FIREFINDER and Air Defense Systems from radiation seeking missiles. Nanosecond microwave and optical transmitters required by systems to locate non-firing hostile weapons will be developed. Passive Devices - Advanced signal processors using surface acoustic wave-charge coupled device technology will be exploited; these spread spectrum techniques will have a significant impact on improving secure jam-resistant tactical command, control, and communications systems. Work on miniature molecular frequency standards will be intensified. Planned display programs can be expected to result in standardization of militarized display technologies incorporating the full range of necessary performance capabilities, thereby allowing more effective display logistics while providing optimum data communications at all levels of the battlefield situation. Power Sources - Improved, low cost, reliable nickel-zinc rechargeable cells will be designed which double the energy density available with conventional (nickel-cadmium or lead-acid) rechargeable cells--such low cost rechargeable batteries are required to support vehicular requirements and meet the need for reliable "float" batteries for emergency power and uninterrupted power system. Feasibility of the advanced alternating current-to-direct current power processor technique will be demonstrated by performance of an experimental 2.5 kilowatt model which will replace present rotary types--which are becoming totally unsuited for modern military needs.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.06.A
DoD Mission Area: #135 - Chemical-Biological Warfare Technology Base

Title: Chemical Biological Defense and General Investigation
Budget Activity: # 1 - Technical Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	11990	9611	9686	13091	Continuing	Not Applicable
	Quantities						Not Applicable
A553	CB Defense and General Investigations	11990	9611	9686	13091	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army, as the DoD Executive Agent, has responsibility for conducting a harmonized interservice RDTE program to provide the essential technology base upon which the Services can develop chemical weapons and chemical and biological defense (CW/CBD) systems on an individual or joint basis to meet their stated military operational needs. This program is designed to provide the interservice technology base for chemical/biological (CB) defense. Exploratory development is conducted to acquire a technological base to counter the threat posed by potential enemy agent/munition systems; to enhance the data bank on all aspects of physical defense including warning, detection, identification, decontamination, individual and collective protection; to investigate compounds of military interest; to evaluate protection countermeasures, avoid technological surprise, and uncover leads for new deterrent agents; and to study agents and methodology for the training of troops. The basic output is knowledge leading toward improvements in CB defense. This knowledge is also usable in advancing the deterrent chemical agents/munitions technology.

C. BASIS FOR FY 1979 RDTE REQUEST: Program will include demonstrating the feasibility of a simplified collective protective system to include new concepts for solving the entry/exit problem; continue to assess effectiveness of chemical agent detection systems against all potential threat agents in all environments; continue process studies on training agents and complete the design, fabrication and testing of a remote sampling and analysis system for detecting biological agents; maintain a continuing program for assessing the potential of foreign chemical agents; and conduct studies into techniques for increasing the burning rates of pyrotechnic/agent systems.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.06.A
DoD Mission Area: #135 - Chemical-Biological Warfare Technology Base

Title: Chemical Biological Defense and General Investigations
Budget Activity: #1 - Technical Base

E. DETAILED BACKGROUND AND DESCRIPTION: This program element supports the entire Department of Defense chemical and biological defense technology base and addresses in-depth exploratory activities in the development of a broad spectrum of equipment concepts for: point sampling and area chemical agent warning systems and detection, sampling and identification equipment; individual and collective protection against respiratory and percutaneous chemical agent hazards; filtration and purification of air and water; personnel and equipment contamination prevention and decontamination; chemical defense training; improvement of safety in military chemical industrial-type operations; airborne biological agent sampling, fractionation, and concentration for point sampling and area scanning-type agent detection and alarm systems; physical protection against and decontamination of biological agents. Program also include investigations supporting both defensive and offensive development in chemical dispersion and dissemination techniques, chemical agent systems process chemistry and pilot operations; and searches for potential chemical agents and toxicology of chemical agents.

F. RELATED ACTIVITIES: No comparable work is done by the other Services. Coordination is maintained with the other Services to assure provision of the technology base to meet their advanced and engineering development needs, adoption of joint service requirements where practicable, and preclude duplicative efforts. Coordination and cooperation is maintained with the United Kingdom, Canada, Australia, and with the North Atlantic Treaty Organization (NATO). Related technical investigations are conducted under PE 6.26.22, "Chemical Munitions and Chemical Combat Support."

G. WORKED PERFORMED BY: In-house by US Army Chemical Systems Laboratory, Edgewood, Maryland. Contractors include Calspan Corporation, Buffalo, New York; Stanford Research Institute, Menlow Park, California; Shock Hydronamics, North Hollywood, California; University of Pittsburgh, Pittsburgh, Pennsylvania; National Health Laboratory, Bethesda, Maryland; Midwest Research Institute, Kansas City, Missouri; Honeywell Incorporation, St. Petersburg, Florida; and Ash Stevens Incorporated, Detroit, Michigan.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: A. Completed exploratory development (ED) on Ionization Detector to enhance the sensing capability of the M8 Chemical Alarm System. B. Examined contamination avoidance techniques and decontamination methods applicable to tactical equipment. C. Identified two concepts for simplified collective protection filters. D. Demonstrated feasibility of a Detector Kit for Chemical Agents in Water. E. Completed evaluation of threat posed by enemy thickened chemical agents.

2. FY 1978 Program: A. Determine feasibility of laser remote sensing techniques. B. Recommend to user candidate decontamination materials and components. C. Complete conceptual studies for simplified collective protection for field shelters and Residual Gas-Life Indicator for large area filters. D. Complete ED on the Detector Kit for Chemical Agents in Water. E. Publish report evaluating foreign threat and vulnerability to toxic agents.

3. FY 1979 Planned Program: The FY 1979 planned program will include demonstrating the feasibility of simplified collective protective system to include new concepts for solving the entry/exit problem. Continue to assess effectiveness of US detection system against all potential threat agents as identified by all Services. Continue process studies on training agents. Complete design, fabrication, and testing of a remote sampling and analysis system. Maintain a continuing program for assessing the potential of foreign agents. Conduct studies into techniques for increasing the burning rates of pyrotechnic/agent systems. Continue to synthesize sufficient quantities of compounds of interest to the various programs for advanced toxicological, chemical and weaponization studies.

4. FY 1980 Planned Program: Continue to assess effectiveness of protective systems of all potential threat agents and effectiveness of chemical agent detection systems to meet Tri-Service requirements/needs. Continue assessment of process studies on training agents and of internal hazards in contaminated vehicles operating in a contaminated environment.

5. Program to Completion: This is a continuing program.

FY 1979 RTD&E CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.07.A
DoD Mission Area: #134-Environmental Sciences

Title: Mapping and Geodesy
Budget Activity: #1-Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3250	4904	4200	4615	Continuing	Not Applicable
A855-T1	Geodesy and Positioning Technology	1043	1540	1446	1105	Continuing	Not Applicable
A855-T2	Topographic Mapping Technology	823	888	1136	1486	Continuing	Not Applicable
A855-T3	Military Geographic Analysis	1384	1620	1618	2024	Continuing	Not Applicable
A355-T4	Army Terrain Information System (ARTINS)		856				

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program investigates and develops methods and equipment to provide the Field Army and Department of Defense with a more responsive, cost-effective capability for collecting, processing, displaying and disseminating geodetic, topographic and military geographic data and products.

C. BASIS FOR FY 1979 RDT&E REQUEST: FY 1979 support to Defense Mapping Agency includes: Continued development of a vehicle-mounted rapid gravity survey system; development of digital techniques for imagery data extraction and elevation determination; and use of holographic and other coherent optical techniques for image data extraction. FY 1979 program support to Field Army includes: gyroscopic azimuth devices for artillery survey application; low-cost optical and inertial techniques for rapid collection of accurate positional data; improved map designs and production procedures for tactical operation and planning; imagery correlation facilities for near-real-time targeting and positioning; advanced methods and materials in support of baseplant and field map reproduction; and experimental instruments for remotely measuring stream velocity, depth and width for river crossing operations.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Program develops new or improved means for rapid acquisition, processing, and dissemination of positional information, mapping data and military geographic information. End items directly support future

map production activities and future strategic and tactical deployment of forces, weapons systems and crises management. Program covers areas of Geodesy and Point Positioning, Mapping, Geographic Analysis, and provides exploratory development portion of the technology base for both the Army and Defense Mapping Agency (DMA). Techniques and equipment developed include: (a) improved position-location data for long-range weapons employment; (b) improved mapping of critical world areas; and (c) mapping, military geographic information (MGI) and terrain analysis for Army tactical operations to include contingency, limited war, general war and rescue operations.

F. RELATED ACTIVITIES: Applies results of basic research performed under Project B52C, Mapping and Geodetic Research, Program Element 6.11.02, Defense Research Sciences. Both Air Force and Navy have related mission-oriented research, which is coordinated with the Army's program by the DMA and the Under Secretary of Defense for Research and Engineering (USDRE). Advanced and engineering development of techniques and equipment resulting from this program are accomplished under the following program elements: DMA Progam Element 6.37.01.B, Mapping, Charting and Geodesy Investigation and Prototype Development; DMA Program element 6.47.01.B, Mapping Charting and Geodesy Engineering Development and Test; Army Program Element 6.37.12.A, Mapping and Geodesy; and Army Program Element 6.47.16.A, Mapping and Geodesy.

G. WORK PERFORMED BY: Approximately 51% of the work is performed in-house at the U.S. Army Engineer Topographic Laboratories (USAETL), Ft. Belvoir, VA. The balance is performed by commercial contractors or other government agencies. Total contractual effort in FY 1979 will be $2.072K. Other government agencies funded for $516K under this project are: Army Research Institute for Behavioral Sciences, Alexandria, VA; Army Computer Systems Command, Ft. Belvoir, VA; US Geological Survey, Menlo Park, CA; and Army Engineer Waterway Experiment Station, Vicksburg, MS. Personnel involved in this program total 41 professional and 20 supporting.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: A prototype-model Rapid Gravity Survey System (RGSS) was developed to satisfy requirements of the Defense Mapping Agency for mobile geodetic capability by the mid-1980s. Video recording and display equipment was procured and installed in the Near-Real-Time Imagery Exploitation Facility and was sucessfully tested at Fort Sill, OK, using artillery-launched TV imagery. A prototype Electrostatic Image Reproducer (EIR) was developed for high-speed, large-format, multicolor reproduction of maps. The initial operational phase of the in-house Digital Image Analysis Laboratory (DIAL) was completed and demonstrated. Experiments in image warping and correlation were successfully demonstrated which will support the Defense Mapping Agency's (DMA) future need to be able to utilize data from advanced collection systems. An experimental map viewing device was fabricated, field tested and evaluated and a draft Letter of Agreement (LOA) was prepared to support follow-on advanced development (6.3A). In the development of Product Test methodologies, accomplishments included the completion of studies on vegetation, drainage, and culture symbology and an investigation of production inks, screens and type styles, the objective of which is to obtain improved map interpretability.

Program Element: #6.27.07.A
DoD Mission Area: #134-Environmental Sciences

Title: Mapping and Geodesy
Budget Activity: #1-Technology Base

2. FY 1978 Program: State-of-the-art study of gradiometer technology is being completed, and design of an integrated inertial/gradiometer system initiated in support of Defense Mapping Agency (DMA)/strategic missile requirements. Development and field testing optical model Remote Stream Measuring Device is underway for use by Military Engineers. In the Development of Multi-Image Interpretation Techniques, a hardware update contract is being completed on the Texture Analysis/Image Processing Module, and work is underway on developing procedures for analog/digital processing of Factor Map Overlays as required for special maps products and terrain analysis operations in support of Field Army needs for terrain information. Work is being completed on the generation of a new symbol file for incorporation into the advanced development graphics. Studies are underway to develop a simplified, all-weather distance/azimuth measuring instrument with automatic read-out for use in Artillery Survey for Weapons Systems. Work is being performed in-house to develop a variable-geometry laser printer in support of DMA baseplant printing requirements. Contractual studies in Optical/Digital Radar Simulation are being completed, with results evaluated for application to the PERSHING II missile program.

3. FY 1979 Planned Program: A prototype integrated Rapid Gravity Survey System (RGSS)/gradiometer system will be evaluated for use by DMA for strategic missile planning. Contractual efforts will be performed to fabricate and test prototype advanced gyros and integrated/optical distance measuring equipment. After coordination with potential users, Letters of Agreement (LOA) will be drafted and staffed. In-house efforts will continue in the development of digital data extraction techniques to include advanced digital correlation methods and techniques for matching dissimilar images for use by DMA in speeding the mapping process by automation. Additonal software will be procured, modified and tested on the Digital Image Analysis Laboratory (DIAL) Facility leading to an all-digital pass point selection/correlation system. Fabrication of the prototype Remote Stream Measuring Device (Non-Optical) will be completed and testing and evaluation begun for Military Engineers. Work will be completed on the radar scene simulation and studies will be performed in-house and by contract to demonstrate the feasiblity of new hybrid (optical/digital) processing techniques, in support of the Pershing II and Remotely Piloted Vehicles. Decrease in RDTE funding from FY 1978 to FY 1979 is due to transition of Army Terrain Information System (ARTINS) exploratory development (Task A855-T4) from this program into Program Element 6.37.12.A, Mapping and Geodesy.

4. FY 1980 Planned Program: Fabrication of a prototype advanced gyro will be completed and delivered for laboratory and field evaluation. An LOA for an all-weather, automated distance/azimuth measuring instrument will be prepared for Army approval. An investigation to determine cost/benefits of upgrading the Topographic Support System (TSS) with advanced printing/reproduction equipment will be completed. Advanced digital image processing techniques feature extraction tests will be concluded, a final report prepared, and a proposal for design of a follow-on digital feature extraction system will be submitted. Efforts aimed at developing accurate image quality evaluation procedures will be completed. Evaluation of a breadboard model stream measuring instrument, capable of precise slant range measurements, will be completed. Results will be documented and used to support proposed follow-on Advanced Development. A contract will be awarded to investigate state-of-the-art techniques for optically processing aerial imagery and to compare optical and digital approaches in terms of speed, resultant accuracies and hardware costs.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.09.A
DoD Mission Area: #121 - Electronic Devices

Title: Night Vision Investigations
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5053	4850	6063	5623	Continuing	Not Applicable
DH95	Night Vision Investigations	5053	4850	6063	5623	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army has a need for a cost effective capability to be able to fight during periods of darkness and limited visibility. Using advanced technologies and new concepts in the field of electro-optics this program develops new techniques, components, and devices that will result in significant cost reductions and/or performance improvements for night vision devices. This capability is required to counter the threat of a foe that plans to continue combat operations during periods of darkness and limited visibility.

C. BASIS FOR FY 1979 RDTE REQUEST: Advanced concepts, based on 2nd generation focal plane technology, will be developed for Remotely Piloted Vehicles (RPVs), Manportable Thermal Imaging Systems, Improved Tank Sights, and Fire and Forget Missiles. Longer wave length technology (millimeter wave) will be studied for providing improved operational capability in fog and smoke. Visionics modeling techniques will be extended to RPVs, Urban Target Acquisition, Smart Weapons, and all weather systems, for prediction of system performance effectiveness. A one inch, flat panel display will be developed for use both in a lightweight helmet mounted display and in the thermal weapon sight. A miniature, low cost, day/night sensor using a Gallium Arsenide Photocathode and Charge Coupled Device (CCD) target will be developed for use in RVPs and Fire and Forget Missiles where expendability is an important factor. Development of sensors in both the 8-14 micron and 3-5 micron spectral regions will be pursued in order to reduce cost and improve the performance of thermal systems. Development of 1-2 micron image intensifiers will be initiated to improve the low light level and adverse weather performance.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: A second generation Manportable Thermal Imager is being developed to eliminate many of the short-comings that exist with the first generation devices, e.g., second generation imagers will be thermoelectrically cooled, hence not having the logistical burden of coolant bottles which need to be refilled with compressed air, weigh about one-half of

what the first generation devices weigh, have a smaller power requirement, and finally be able to provide the increased ranges required by systems such as the Advanced Heavy Antitank Missile System (AHAMS). The logistics necessary to support the first generation devices include unique equipment to clean and charge bottles with compressed gas. Higher performance second generation Thermal Imagers will be developed to provide detection ranges of up to These increased stand-off ranges will increase the survivability of attack helicopters. When the currently developed Night Vision Goggles are used by a helicopter pilot, difficulty is experienced in changing the focus of the goggles from the horizon to the aircraft instruments. A helmet mounted flat transparent panel display is being developed through which the pilot will be able to observe his instruments and on which he will see an intensified view of the terrain surrounding the aircraft without making a manual focus adjustment. An interchangeable third generation tube is being developed that will cost significantly less ($800-$1200 versus $2200) than the second generation tube, have significantly better performance, and detect a man at a range twice that at which it can currently be done with the second generation tube. This will result in significant savings since the Army is expected to procure in excess of 30 thousand devices which use the second generation 25 millimeter image intensification tube, e.g., individual weapon sights.

F. RELATED ACTIVITIES: Close coordination is maintained with the Navy, Air Force, and Marine Corps to avoid duplication. Joint Logistics Commanders coordinating groups have been established to ensure that maximum use is made of limited assets, e.g., Navy is developing 8-14 micron second generation infrared detectors while the Army is developing those sensitive to 3-5 micron energy. The Army has responsibility for the Configuration Management of the first generation Thermal Imaging Common Modules used by all Services. In addition, an active international program of technical cooperation is maintained with many countries, particularly those of NATO and the Quadripartite countries.

G. WORK PERFORMED BY: Night Vision Laboratory, Fort Belvoir, VA. Representative contractors are: Radio Corporation of America, Lancaster, PA; International Telephone and Telegraph Corporation, Fort Wayne, IN; Varian Associates, Palo Alto, CA; Texas Instruments, Inc., Dallas, TX; and Philco Ford Corporation, Aeronutronics Division, Newport Beach, CA.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Developed lower cost, higher sensitivity 18 millimeter third generation image intensification tubes. This was preceeded by development of first and second generation image intensification tubes for night vision goggles and small starlight scopes. 3-5 micron monolithic silicon focal planes were developed for long range airborne applications, and 8-12 micron hybrid lead-tin-telluride. Through the use of Charge Coupled Devices (CCD) and Large Scale Integration technologies, it has been possible to increase the number of detectors by a factor of 100, hence substantially increasing the range and limited visibility performance of night sights. These developments were preceeded by development of the first generation of thermal imaging night sights.

Program Element: #6.27.09.A
DoD Mission Area: #121 - Electronic Devices

Title: Night Vision Investigations
Budget Activity: #1 - Technology Base

2. FY 1978 Program: In the Visionics Area, models to predict sensor effectiveness will be expanded to include smoke, fog, and haze effects; heliborne sensor platforms; laser range finders; and lock on before launch smart weapons. Programs will be initiated to develop a flat panel helmet mounted display for use by helicopter pilots, and a miniature camera tube possibly applicable to Remotely Piloted Vehicles (RPVs). A second generation Thermal Imaging program to demonstrate high density detector focal planes, with up to 20,000 detectors, will be initiated. Collect target and background data for future millimeter wave imaging systems. The potential for application of Infrared (IR) staring array technology to a low cost day/night sensor for target imaging and missile homing will be explored. Uncooled, high performance IR imagers will be evaluated for applications such as driving through smoke and fog. Development of Hi-Sensitivity Tank (HISTAF) and Advanced Tactical (ATAC) helicopter thermal night sights will be initiated. HISTAF will double the low visibility recognition range of the current tank sight, while ATAC will increase helicopter stand-off ranges by a factor of three or better.

3. FY 1979 Planned Program: Far Infrared: High performance silicon detectors will be fabricated for long range heliborne and armored vehicle use. Miniature Devices: Evaluate third Generation Intensification Galium-Arsenide Photocathode/Charge Coupled Device (CCD) intensification tube for use in Remotely Piloted Vehicle (RPV) television camera, fire and forget missiles. Evaluate lightweight, flat panel, helmet mounted pilots display, also called holographic one tube (HOT) goggle. Expand dynamic search models for urban backgrounds including multi-spectral signatures. Fabricate nonscanning thermoelectrically (TE) cooled staring focal plane (third generation thermal) sensor, possible application in automatic tracking imaging of smart munitions in the mid 1980's. The $1.2 million increase in FY 1979 over FY 1978 is to provide funds to procure a Schermflug probe, which is a device used to collect data for the evaluation and optimization of airborne night vision systems.

4. FY 1980 Program: Demonstrate Remotely Piloted Vehicle (RPV) mini-FLIR (Forward Looking Infrared Device) with a second generation focal plane array for extending resolution and sensitivity. Complete Concept Formulation of advanced infrared tracker. Initiate development of a handheld staring sensor prototype based on trade-off analysis between thermoelectrically (TE) cooled staring arrays and solid state pyroelectric technology. Complete feasibility of 8-14 micron hybrid focal plane detector array for High Sensitivity (HISTAF) FLIR for tanks. Establish feasibility of TE cooled 3-5 micron focal planes for staring detector arrays. Evaluate advanced monolithic silicon (MOSIS) chip for potential of upgrading performance of Advanced Tactical (ATAC) FLIR. Initiate exploratory development phase of uncooled solid state thermal imager. Demonstrate 18mm diameter photocathodes sensitive to 1-2 micron radiation. Modify effectiveness models to include threat countermeasures.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.15.A
DoD Mission Area: #122 - Electronic Warfare Technology

Title: Tactical Electronic Warfare Technology
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT					Continuing	Not Applicable
A042	Tactical Self-Protection Electronic Warfare Techniques					Continuing	Not Applicable
A904	Tactical Electronic Warfare Techniques					Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element supplies the exploratory development technology in support of all Army Electronic Warfare (EW) programs. Technologies from voice frequencies through radar and optics are utilized to provide new concepts of countermeasures (CM) and counter-countermeasures (CCM). Technological advances are urgently needed to support development/fielding of electronic/signals warfare equipments. Present size, weight, location accuracy, limited output power, and sophisticated signal processing techniques are some of the many system characteristics which must be solved by modern technology to ensure the use of the frequency spectrum to friendly forces while denying its use to the enemy. The rapidly increasing use of precision guided weapons necessitates a corresponding effort in the detection and countering of such threats. Investigation and development is continuing to insure that the latest developmental US missiles, communications, electronics, and night vision systems will function satisfactorily in a hostile countermeasure environment.

C. BASIS FOR FY 1979 RDTE REQUEST: Major Technology thrusts will be pursued in the following areas:

threat warning and CM's against electro-optical guided or aided weapons; the achievement of optimum jamming modulations to counter weapons systems associated communications and non-communications systems; and, in conjunction with the US Air Force, develop jamming mission system techniques for eventual configuration on a common remote piloted vehicle airframe. These goals will be pursued primarily through a continuation of work initiated in FY 1978. Waveforms for defeating radars will be optimized and the development of jamming sources will be initiated. The effectiveness of various

jamming techniques against missiles will be established, improved jamming sources designed, and threat warning techniques investigated. The feasibility of fully automatic electronic countermeasures (CM's) for protection from laser guided weapons will be established and efficient laser jamming sources developed. field tests of an experimental system for the detection, location, and identification of hostile passive optics will be completed and system requirements established. An improved airborne jamming antenna with matching unit will be experimentally evaluated on a UH-1 helicopter. Techniques for jamming enemy radar will be demonstrated. Investigations of techniques to increasethe resistance to jamming of communications systems will concentrate on the to microwave data links. An effort to conduct various modulation effectiveness measurements will be initiated. The objective is to optimize jamming modulations that will provide a minimum effective jamming to signal ratio for use against enemy threat radars. Optimizing the modulation jamming to signal ratio will effectively utilize the effective radiating power in existing and future radar jammers. A high power communications jamming amplifier will have been designed The amplifier will be constructed in FY 79 for operational and feasibility testing necessary to demonstrate potential for future jammer applications. A program will be started in FY 79 for the application of electron bombarded semi-conductor techniques in the radar jamming area. These devices offer great advantages over tubes or transistors in reduced size and greater power handling capability, bandwidth and linearity. This is a joint program with the Navy Electronics Systems Command. In the Remote Piloted Vehicle (RPV) mission system techniques area, a prototype very high frequency communications jamming system will be developed for configuration on the common Army/Air Force RPV airframe. This is a joint program with the Air Force Drone Special Projects Office.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is the exploratory development of tactical electronic warfare, to include electronic countermeasures (ECM) and electronic counter-countermeasures (ECCM), techniques, components and equipments to be targeted against enemy communications and non-communications systems (including electro-optics and infrared communications and non-communications) associated with enemy weapons systems and units. New and improved methods and techniques will be developed to provide for improvement of jamming (overt and deceptive) and ECM/ECCM control by increasing effectiveness while reducing size and weight and increasing reliability. This program is also founded on the need for continuous improvement of existing techniques and the development of new techniques for dealing with advances in the state-of-the-art. As methods of communications/electronics become more sophisticated, equipment must also become more sophisticated if we are to adequately counter new threats. Technology development is also required to minimize the total cost of development, acquisition and operation of electronic warfare equipment.

The vulnerability of the techniques and methods will also be considered.

Program Element: #6.27.15.A
DoD Mission Area: #122 - Electronic Warfare Technology

Title: Tactical Electronic Warfare Technology
Budget Activity: #1 - Technology Base

F. RELATED ACTIVITIES: This work is in direct support of the Program Manager for Aircraft Survivability Equipment and of programs/projects 6.37.45.A/D905 (Tactical Electronic Support Measures (ESM) Systems), 6.37.45.A/D925 (Tactical Electronic Warfare and Intelligence Command and Control Systems), 6.37.55.A/D251 (Protective Electronic Warfare (EW) Equipments), 6.37.55.A/DK12 (Division Tactical Electronic Countermeasures (ECM) Systems), 6.37.55.A/DK13 (Corps Tactical ECM Systems), 6.47.45.A/D906 (Tactical ESM Systems), 6.47.45.A/D926 (Tactical Electronic Warfare and Intelligence Command and Control Systems), 6.47.50.A/DL12 (Division Tactical ECM Systems), and 6.47.50.A/DL13 (Corps Tactical ECM Systems). Work on the development of electronic counter-countermeasures (ECCM) technology supports numerous Army electronics systems in the area of communications and radar. Tri-Service technical efforts in electronic warfare receive extensive review as a result of participating in Joint-Service Technical Programs (JSTP), Electronic Counter-Countermeasure Workshops (ECCW) and Joint Technical Coordinating Groups (JTCG) which reduce duplication among the Services. Coordination is also furthered through Tri-Service preparation of a Technology Coordinating Paper on Electronics and the annual reviews by the Under Secretary of Defense for Research and Engineering (USDRE) reviews. Numerous specific subtasks are conducted on an inter-service basis including work on radar jamming, optical and electro-optical countermeasures, missile threat detection, laser jamming sources, and optical augmentation. This takes the form of joint funding/coordination with other Services.

G. WORK PERFORMED BY: The US Army Electronics Research and Development Command (ERADCOM), Adelphi, MD; Electronic Warfare Laboratory (EWL), Fort Monmouth, NJ; US Army Signals Warfare Laboratory (SWL), Arlington, VA; and White Sands Missile Range (WSMR), NM. Approximately three personnel at SWL and 10 personnel at EWL are involved with program management, contract monitoring and a limited amount of in-house laboratory experimentation and modeling. Supporting efforts are provided by the Army Armament Research and Development Command, Picatinney Arsenal, NJ; Letterman Research Institute, San Francisco, CA; Naval Weapons Center, China Lake, CA; Georgia Institute of Technology, Atlanta, GA; Pacific Missile Test Center, Point Mugu, CA; Air Force Avionics Laboratory, Wright Patterson Air Force Base, OH. Contractors include: Hughes Aircraft Company, Culver City, CA; Stanford Research Institute, Huntsville, AL; GTE Sylvania, Mountain View, CA; RCA Corporation, Princeton, NJ; Honeywell, Incorporated, Lexington, MA; Rockwell International, Anaheim, CA; Quest Research Corporation, McLean, VA; ITEK Corporation, Lexington, MA; and Bunker Ramo Corporation, West Lake Village, CA.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Techniques were demonstrated to provide lower cost, fast frequency hopping, very high frequency (VHF) communications with high dynamic range, low loss, steerable null antenna components. These accomplishments transitioned to SINCGARS (Single Channel Ground Air Radio System). In addition, a microwave steerable null antenna processor utilizing a unique antenna array was designed. A millimeter wave intercept receiver was designed and built in-house and a laser receiver modified for employment in an overseas project. A compact dye-in-plastic laser module with efficiencies and lifetimes comparable to liquid systems was constructed to evaluate its application to a helicopter-mounted Optical Warning Location/

Detection System (UWLD). An ultra violet (UV) filter was developed and incorporated in the AN/AAR 41 missile detector and a report, "UV Signatures of Tactical Missile Plumes", including spectral, temporal, and radiometric missile signatures was compiled. Computer simulation demonstrated a countermeasure (CM) for degrading a hostile laser radiation weapon and data was collected on the effect of counterfire for suppressing a laser designator. A program initiated in FY 1977 analyzed the polarization signatures of several hostile optical systems and evolved a novel measurement technique which should permit remote target identification. Surface acoustic wave (SAW) and charge coupled device (CCD) technologies were successfully combined to produce a high speed signal digitizer applicable to a variety of electronic warfare (EW) processing requirements. A SAW transform processor which offers potential for providing an instantaneous direction finding (DF) capability was demonstrated. Design improvements for an expendable smart communication jammer were completed. Current engineering development of communications and non-communications jammers indicate that there are areas which require advanced technology in order to provide for increased effective radiating power at no increase in input power. A program has been initiated to optimize jamming modulations that will provide a minimum jamming to signal ratio effective for enemy threat radars. Optimizing the modulation jamming to signal ratio will effectively utilize the effective radiating power in existing and future radar jammers. A small effort was conducted in adaptive jamming techniques which led to the initiation of a program to develop an electronic bombarded semi-conductor for use in a high power - communications amplifier. The feasibility of conducting communications electronic warfare from a Remotely Piloted Vehicle (RPV)/drone was demonstrated. Testing proved RPV communications jamming to be feasible.

2. FY 1978 Program: Develop improved jamming waveforms and simulate their effectiveness against modern radars. Utilize in-house test results to initiate development of a CM to jam hostile radar. Demonstrate improved laser sources for interrogation and jamming. Increase the peak power of laser diodes for rangefinder jamming, develop tunable laser jamming sources, and solid state down-conversion oscillators for optical augmentation. Collect additional data essential to the design of an ultra violet missile detection system and explore improved detector/filter combinations. Implement a generic simulation which will permit a rapid assessment of infrared (IR) jammer performance against new missiles. Develop an IR power source compatible with the basic IR jammer and explore selective emitters. Complete evaluation of counterfire for suppression of laser designators and finalize requirements for a counterfire system. Complete an optical polarization sensitive receiver and demonstrate its use for target identification. Award contracts.

Expand the Steerable Null Antenna Processor (SNAP) concept for application to transmitters as well as receivers by design of diode-switched microstrip phase shifters and initiate construction of a feasibility model. Develop a biodegradable chaff in order to meet Environmental Protection Agency (EPA) requirements which currently limit vulnerability testing of weapon systems. Investigate the previous efforts in radar jamming modulation analysis. Attempt to correlate finding of previous studies with respect to various modulations and their effectiveness against various threat radars. A high power communications

jamming amplifier will be designed which will utilize electron bombarded semi-conductor active devices rather than conventional tubes and transistors. The design will include all the necessary support circuitry and mechanical packaging necessary to prove feasibility in other than laboratory environments. Adapt or build specific Remotely Piloted Vehicles (RPV)/drone jamming packages which can be optimized for use in specific operational situations. All work will center around an ultimate total system to include commonality and interchangeability. Specifications will be derived for the adaptation of a hand emplaced "smart" jammer into an RPV/drone.

3. FY 1979 Planned Program: Use an Air Force test bed to field test improved jamming techniques and develop a modulator for generating the required jamming waveforms. Complete and test an improved breadboard jammer and define system requirements. Investigate countermeasure (CM) techniques against other low altitude avionics. Improve efficiency and tuning for Stimulated Raman Scatter laser sources and build injection diode arrays for jamming appropriate laser systems. Utilize infrared countermeasure (IRCM) simulation to analyze jamming waveforms against likely modifications to existing missiles, develop efficient long wavelength jamming sources; and define requirements for improved CM flares. Demonstrate the feasibility of CM against a guided missile (ATGM) and prepare detailed requirements for a fieldable system. Complete a field test plan Design and field test an automated system for detection, location, and identification of optical targets and field test. Initiate development of an exploratory model hybrid surface acoustic wave/charge coupled device (SAW/CCD) . Develop multiple loop techniques capable of independently nulling jamming or interfering signals for use with radio sets. Complete development of a microwave steerable null system and participate in PATRIOT air defense missile communications tests involving line-of-sight ultra high frequency (LOS-UHF) data links. Field evaluate experimental chaff which conforms to Environmental Protection Agency (EPA) requirements. Required acceleration of Electronic Warfare technical base effort results in increase in funds from FY 1978 to FY 1979. Conduct various modulation effectiveness measurements against weapons systems associated radars. Derive parametric curves and conduct trade-off analyses between barrage jamming and other sophisticated modulations. The high power communications jammer utilizing electron bombarded semi-conductor active devices rather than conventional tubes or transistors will have been designed. The amplifier will be constructed in FY 79 for operational and feasibility testing necessary to demonstrate potential for future jamming applications. A program will be started in FY 79 for the application of electron bombarded semi-conductor technology in the radar jamming area. This is a joint program between the Army's Signals Warfare, Electronic Warfare and Electronic Technology and Devices Laboratories and the Navy Electronics System Command. In the Remote Piloted Vehicle (RPV) mission system techniques area, a prototype very high frequency communications jamming system will be developed for configuration on the common Army/Air Force RPV airframe. This is a joint program with the Air Force Drone Special Project Office.

Program Element: #6.27.15.A
DoD Mission Area: #122 - Electronic Warfare Technology

Title: Tactical Electronic Warfare/Intelligence Technology
Budget Activity: #1 - Technology Base

4. FY 1980 Planned Program: Develop new approached for defeating sophisticated anti-jamming modifications to enemy radars. Explore countermeasure techniques against advanced precision guided weapons, and provide an order of magnitude reduction in the size and weight of advanced electronic warfare hardware. Develop a high power radar jamming antenna system for eventual installation on airborne or ground vehicular systems. Continued development is necessary to increase antenna band widths, reduce size and weight and to develop new techniques to improve the antenna effective radiating power without increasing system power. All individual Remotely Piloted Vehicle (RPV) jammers and the control station will complete development and a piloted vehicle test will be conducted, after successful completion of which the mission systems will be integrated into RPV. An RPV feasibility test will be conducted during the third and fourth quarters. Advanced development will be initiated

5. Program to Completion: This is a continuing program. As methods of communications/electronics become more sophisticated, our electronic warfare equipment must also become more sophisticated if we are to adequately counter new threats.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.16.A

Title: Human Factors in Military Systems

DoD Mission Area: #132 - Training and Personnel Technology

Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3716	3950	5922	7271	Continuing	Not Applicable
AH 70	Human Factors in Military Systems	3716	3950	5922	7271	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army uses thousands of different items of equipment, often under the most adverse environmental and combat conditions. Objective of this program is to assure that future Army equipment is designed so that the soldier can fight effectively without fighting the equipment. Specific purposes are: (1) provide knowledge of the soldier's mental and physical performance capabilities and limitations; (2) guide the application of that knowledge in the development of Army weapon systems so that the soldier (both male and female) can mentally and physically operate and maintain; (3) combine human task performance with machine performance to achieve the most effective, efficient and reliable combination.

C. BASIS FOR FY 1979 RDT&E REQUEST: The US Army Human Engineering Laboratory (HEL) has developed outstanding expertise in performing new weapon system concept feasibility analyses, and total weapon system effectiveness evaluations. Laboratory and field evaluations reveal total weapon system error sources; components inefficiently operated by the typical soldier are identified and recommendations made to achieve greater effectiveness through equipment redesign and procedural or training improvements. FY 1979 R&D will be as follows: (1) Armor: Initiate first series of live firing, scaled tank range assessments of human factors requirements in the design of tank fire control systems; (2) Artillery: Complete analysis of Human Engineering Laboratory Battalion Artillery Test VII (HELBAT VII) data; continue to assist US Army Training and Doctrine Command (TRADOC) to insure the appropriate integration of all newly developed materiel into a totally integrated artillery system; (3) Aviation: Transition Integrated Helicopter Flight Control to US Army Aviation R&D Command (AVRADCOM) and monitor its further development; Conduct HEL portion of Tri-Service Helicopter Human Factors Engineering R&D program and monitor portions assigned to other DARCOM agencies; (4) Infantry: Conduct first combined arms field test to determine command and control problems, proper mix of weapons and materiel and compatibility of equipment; (5) Clothing & Equipment: The proliferation of items intended for individual soldier portability has exceeded the capacity of the soldier's packframe (ALICE). Alternate solutions range from major modification of the ALICE packframe to the development of pack systems specific to a weapon system. A systematic investigation will be undertaken to determine the "best" means of portability for specific systems. All such R&D will be coordinated with US Army Natick R&D Command (NARADCOM);

Program Element: #6.27.16.A

Title Human Factors in Military Systems

DoD Mission Area: #132 - Training and Personnel Technology

Budget Activity #1 - Technology Base

(6) Night Vision/Smoke: Conduct field experiments to determine the soldier's ability to navigate and accomplish various combat tasks in smoke. Conduct similar experiments with crew served weapons and armor; (7) Air Defense: Conduct more realistic, sophisticated experiments to assess operator performance on follow-on systems or modifications to PATRIOT-type air defense systems; (8) Maintenance R&D: Monitor tests of the Integrated Technical Documentation & Training (ITTDT) effort and improve methods of presenting maintenance information via media other than maintenance manuals. (9) Concept Development: The Human Engineering Laboratory is increasingly involved in developing "quick solution" type components and/or weapon system concepts such as DRAGON anti-tank weapon on the M113 armored personnel vehicle, Ammo Resupply Vehicle, etc. All such appropriate requirements will be properly coordinated with DARCOM Commands and US Army Training and Doctrine Command (TRADOC), to avoid duplication of efforts, and always transitioned to the appropriate DARCOM commands for final development and production purposes; (10) HEL Detachments: All detachments within DARCOM and HEL liaison personnel at TRADOC Centers/Schools will be in full operation by FY 79. This will close the complete loop of providing human factors inputs into materiel requirements documents, concept development studies, supporting the Project Managers and DARCOM R&D Commands, assisting DARCOM testing and evaluation agencies, and finally assisting in the "handoff" process to the commanders in the field by insuring that all supporting material is given to the Commanders simultaneously, i.e., maintenance manuals and training programs and devices.

D. OTHER APPROPRIATION FUNDS:

($ in Thousands)	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to completion	Total Estimated Costs
Military Construction (MCA Funds)	0	0	0	5199	0	5199

E. DETAILED BACKGROUND AND DESCRIPTION: Significant findings from this program have driven the development of such equipment as the (1) Battery Level Computer for the Fire Direction Center for artillery, (2) the TOW Antitank Weapon System, (3) new infantry body armor and helmets, (4) an integrated one-handed flight controller for helicopters, (5) fire control equipment for tanks, (6) target acquisition and control systems for conventional artillery, (7) mounting antitank weapon systems (DRAGON) on the M113 armored personnel vehicle, and (8) providing protection for ammunition handlers in combat loading the M60 tank under fire. Results of this program directly influence the design of Army materiel. The 8 examples cited above have resulted in improving artillery fire accuracy by orders of magnitude, increased soldier protection by 30%, decreased pilot workload by 25%, increased target hit capability from ___ ___

F. RELATED ACTIVITIES: Joint services actions such as publication of Military Specification MIL-H-46855A, Human Engineering Requirements for Military Systems, Equipment and Facilities; Military Standard MIL-STD-1474A(MI), Noise Limits for Army Materiel, Military Standard MIL-STD-1472B, Human Engineering Design Criteria for Military Systems, Equipment and Facilities, and

MIL-HDBK-759, Human Factors Engineering Design for Army Materiel. Among the services, information on current programs and completed results is exchanged to preclude duplication of effort. A Human Factors Engineering Information Data Bank used by all Department of Defense agencies and contractors is maintained by this program. Related Program Elements are: 6.27.57N, Training and Human Engineering Technology, 6.37.01.N., Human Engineering Development.

G. WORK PERFORMED BY: In-house agencies: US Army Human Engineering Laboratory (HEL), Aberdeen Proving Ground, MD, and Human Factors Engineering Detachments at each of the US Army Materiel Development & Readiness Command (DARCOM) Subordinate Commands and Development Centers. Contract organizations whose contracts exceed $25,000 are: Bolt, Beranek & Newman, Inc., Cambridge, MA; and Aircraft Armament Corporation, Cockeysville, MD, and Food Machinery Corporation, San Jose, CA, Georgia Tech University, Atlanta, GA.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments:

Human Factors Engineering design handbooks, standards and specifications were published. Human factors engineering data bank established, containing the results of approximately 30 years of research. Field evaluation showed that conventional artillery was ineffective in engaging moving ground targets. Through use of a new laser designator system and a new automated Fire Direction Center, conventional artillery engagement of stationary and moving ground targets became extremely effective. Tests yielded effectiveness data on air-to-ground and ground-to-air engagements. Integrated flight control was designed which combines two helicopter flight controls into one control. Control frees one of the pilot's hands for other functions such as firing of guns. Field experiments with the 81-mm mortar reduced the number of rounds of ammunition to get on target, and reduced time to get on target, thus increasing mortar-system efficiency and reducing ammunition and training costs. Program supported development of proposed new infantry helmet and body armor through laboratory and field trials involving approximately 1500 infantry soldiers to assure the best shape, sizing, protection (including female soldiers), and compatibility with other equipment. Feasibility of firing rocket-type antitank weapons from enclosures and bunkers was demonstrated. Results are guiding preparation of combat operational guides. US Army Human Engineering Laboratory successfully mounted the DRAGON antitank weapon on the M113 armored personnel vehicle. Gunners achieved , hit probability against stationary targets, and against moving targets. This mount is presently being procured in large numbers for operational use. As a spin-off of an error measuring device development for artillery gun crews, the potential for use as a training device was immediately recognized. This device will save the Army millions of dollars in artillery ammunition, petroleum, oil & lubricants (POL), and gun tube wear annually, in artillery gun crew training. Feasibility of use in training has been successfully demonstrated.

Program Element: #6.27.16.A Title Human Factors Military Systems

DoD Mission Area: #132 - Training and Personnel Technology Budget Activity #1 - Technology Base

2. FY 1978 Program:

Artillery and Mortars: Field tests continued to investigate techniques, equipment and procedures for reducing the remaining human error sources in artillery and mortar firing. Program was initiated to examine the infantry operations such as mechanized, air mobile, and Military Operations in Built-up Areas (MOBA), and the interaction of weapons and equipment as they affect the performance of the infantry soldier. Objective is greater compatibility between new infantry materiel items and to increase the combat infantryman's effectiveness. There is now no systematic human factors assessment of problems associated with military operations in urban warfare. Research was initiated to isolate problems in city fighting and to assess the advantages and limitations of current weapons in such an environment before new, specific materiel development programs are initiated by the US Army.

3. FY 1979 Planned Program:

Continue and extend human engineering work contributing to optimum future infantry, artillery, armor, aviation, and anti-tank weapon systems; develop human factors design criteria for future, optimum lightweight, highly mobile tanks; complete final test, and transition the one-handed flight control for Army helicopters into the next phase of development; with the Army user, determine optimum weapons and procedures for fighting in urban areas.

4. FY 1980 Planned Program:

Conduct specific exploratory development R&D as part of an integrated Human Factors Engineering R&D Program in support of Army helicopter development; extend Military Operations in Built-up Area (MOBA) R&D to include determining the feasibility of new weapon concepts in village and city fighting; continue to develop new Army materiel prototype concepts.

5. Program to Completion:

This is a continuing project.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.17.A
DoD Mission Area: #132 - Training and Personnel Technology

Title: Army Personnel and Manpower Technology
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1971	3000	4392	4696	Continuing	Not Applicable
A766	Manpower Systems Technology	979	900	1380	1126	Continuing	Not Applicable
A767	Technology for Increasing Soldier Productivity	992	900	1300	1370	Continuing	Not Applicable
A779	Techniques for Organizational Effectiveness & Management Training	0	1200	1712	2200	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program seeks to develop technology to enhance effectiveness of the Army's personnel system in meeting requirements for (1) officer and enlisted quantity, quality, and specialization needs in the Active and Reserve Army; (2) improved soldier productivity; and (3) improved Army organizational effectiveness.

C. BASIS FOR FY 1979 RDTE REQUEST: The following is expected to be accomplished: techniques for reducing first term enlisted attrition; improve reserve force management techniques by developing and evaluating incentive programs for enlisted accessions, reenlistments and retention; developing a career commitment model in recruitment, training and retention of Reserve Officer Training Corps (ROTC) cadets and junior officers to improve cost-effectiveness. Improvement in Army unit readiness by developing more reliable methods for measuring organizational and unit performance, by establishing relationships between organizational structures and processes and operational effectiveness, and by developing improved instruments and techniques for diagnosing and solving organizational problems in order to achieve higher readiness.

D. OTHER APPROPRIATION FUNDS: Not Applicable

E. DETAILED BACKGROUND AND DESCRIPTION: Previous technological based work has established the potential for developing promising breakthroughs in the following areas: attrition management controls for reducing accession requirements and increasing return on training investment; reserve enlistment/reenlistment incentives for reducing personnel shortfalls and improving readiness; reenlistment standards for career force selection; computerbased mobile recruitment and examining systems to improve efficiency of personnel accessioning processes; Reserve Officer Training Corps (ROTC) cadet/junior officer measurement during early career performance for performance-based selection and training; mobilization population aptitudes/skills inventory for better standardization of personnel selection tests and improved classification and assignment of new accessions; officer career progression

systems for satisfying officer requirements of specialization and general experience; measure of productivity effectiveness and their relation to techniques for managing personnel; development of managerial and leadership techniques that are maximally effective in enhancing and maintaining performance of Army units and organizations.

F. RELATED ACTIVITIES: This work is coordinated with that of the Air Force Personnel Utilization Technology, Program Element 6.27.03.F and Navy Personnel Support Technology, Program Element 6.27.63.N, through the Under Secretary of Defense For Research and Engineering (USDRE) Selection and Classification Topical Reviews, annual participation in the Military Testing Association, and USDRE Budget and Apportionment Reviews and tri-service committees in such areas as aptitude testing and computerized adaptive testing.

G. WORK PERFORMED BY: Contractors include: Geller Associates, Arlington, VA; General Research Corporation, McLean, VA; Columbia University, New York, NY; Litton-Mellonics, Sunnyvale, CA; Richard A. Gibboney Associates, Inc., Kensington, MD; University City Science Center, Philadelphia, PA; Personnel Decisions Research Inc., Minneapolis, MN; Systems Development Corporation, Santa Monica, CA; McBer & Company, Boston, MA; Advanced Resources Research Organization, Washington, DC. In-house work is performed by the US Army Research Institute, Alexandria, VA. There will be approximately three additional contractors for a total dollar value of $550,000.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: New personnel selection test for screening enlistment applicants with potential for poor adjustment to Army life transferred to advanced development project A768, Program Element 6.37.31.A, Military Personnel Performance Development and Assessment. Factors underlying retention of best qualified personnel were developed to reduce attrition costs which are now in the order of seventy million dollars per year. Exploration of advancements in computer technology for increasing efficiency of personnel accessioning processes. Factors were determined which predict late first tour attrition for development of effective management controls. Job motivation and productivity factors of women in traditionally male jobs and institutions were investigated. Factors underlying military manpower retention. Investigation of factors which predict late first tour attrition. Initial development of an integrated personnel accession, development, and career management system in support of the Officer Personnel Management System was completed. Significant factors affecting recruitment and retention of quality manpower in regular Army and Reserves were determined. "Duty Module" which defines the performance requirements of Army officer assignments in terms of specific functional integrated sets of skills was developed. A career commitment model to assure personnel with appropriate skills are available for appropriate positions at the appropriate times was explored. Systematic analysis of occupational requirements for Army jobs was performed.

2. FY 1978 Program: Factors in first tour attrition-leaders perspective of individuals being separated and individuals remaining in the service, and attrition as a function of leadership behavior and environment factors. Experimental and operational predictors of career soldier success. Improved concepts and technology to support an improved Army officer accession and utilization system, including cost benefits. Training Information Feedback system to support officer training needs. Methodology

for relating measures of individual performance to unit performance. A theoretical foundation and an experimental data base to support officer recruitment, selection, and training. Prototype integrated officer personnel accession, development and career management system model. Research on acceptance of women in the Army careers. More reliable methods for measuring organizational and unit performance so as to be able to evaluate the impact of organizational effectiveness technologies on unit readiness. A model for understanding and predicting how leadership and managerial factors affect organizational and unit effectiveness. Development of a knowledge base relating unit structures and processes to organizational effectiveness.

3. FY 1979 Planned Program: Technological based efforts will be continued on the following Army problems: late first tour enlisted personnel attrition; incentives for Active Army and Reserves; computerization of the enlisted personnel accessioning system; mobilization population inventory to improve standardization of military aptitude and ability testing; development and evaluation of Army officer acquisition and training programs and techniques to develop initial command and staff skills; career progression systems to use resources of the officer corps effectively; factors affecting career commitment decisions of quality officer personnel; indices of unit readiness based on combinations of individual measures; integrated selection, training, and retention system for Reserve Officer Training Corps (ROTC) cadets and company grade officers; male/female differences in command, supervisory, and staff positions; trends in attitudes toward women; establishment of a longitudinal data base which will permit tracking changes in readiness of Army organizations in order to monitor the long term impact of Organizational Effectiveness technology on unit performance; refinement of methods for measuring unit and organizational performance as required in order to facilitate application of cost-effectiveness assessment methodology to the outcomes of Organizational Effectiveness techniques. The Army is deeply concerned about effective utilization of the quality and quantity of manpower available to the Active and Reserve components. Research efforts are required to meet the Army's Five-Year plans in: acquiring and retaining quality personnel; determining personnel and situational factors to improve soldier productivity; developing practical methods for improving the operational capability of organizations. Increased funding required in FY 79 for technology base efforts to develop measures of individual and unit productivity and effectiveness to enhance utilization of women in enlisted and officer positions and to develop applications of cost-effectiveness methodology to Organizational Effectiveness programs.

4. FY 1980 Planned Program: Technological based programs will develop methodology and technology to solve Army problems in the following areas: enlistment and reenlistment motivations and incentives; valid, job-relevant standards for selecting career soldiers; extension of computer-assisted testing to include computer-based recruiting information, job counseling, vocational planning, and training assignment; strategies, techniques, methods, and models for officer accession, training and career development; feasibility of developing techniques for improved combat crew selection; continued development of longitudinal data base for assessing effectiveness of Army units and organizations; development of alternative delivery systems for organizational effectiveness technology so that organizations will not be limited in utilization of this technology by unavailability of school trained personnel.

5. Program to Completion: This is a continuing program.

FY 1979 RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.19.A
DoD Mission Area: #153-Military Engineering Technology Base

Title: Mobility and Weapons Effects Technology
Budget Activity: #1-Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL PROGRAM ELEMENT	2631	3855	4915	5286	Continuing	Not Applicable
AT40-A1	Weapons Effects and Protective Structures	1680	1640	2005	2221	Continuing	Not Applicable
AT40-A2	Lines of Communications and Mobility Engineering	851	1885	2230	2350	Continuing	Not Applicable
AT40-A3	Geoscience Techniques and Methodologies	100	250	500	535	Continuing	Not Applicable
AT40-A4	Field Tests and Battlefield Performance Criteria	0	80	180	180	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Fighting a numerically superior force and the Army's employment of new, sophisticated weapons on the modern battlefield requires maximum exploratory development in military engineering to provide: (1) ground mobility and counter-mobility technology to insure that the battlefield terrain is used to our maximum military advantage, (2) knowledge of basic explosives effects and response of structures and facilities to nuclear and conventional weapons for effective targeting and defensive operations, and (3) techniques to speed completion of military construction and damage repair in support of combat and logistical elements in the theater of operations.

C. BASIS FOR FY 1979 RDT&E REQUEST: Rapid bomb damage repair of pavements (airfields, roads, storage areas) utilizing rapid setting cements will be developed to provide quick recovery of tactical and strategic mobility in the event of enemy weapons strikes on military lines of communication. Employment techniques for bulk explosive now under development will increase battlefield construction capability by 50-100% in both anti-tank obstacles and fighting positions. Criteria and computer codes for the design and evaluation of fortification and hardened underground structures to survive the effects of nuclear and conventional weapons will be developed. Methods for predicting the performance of combat vehicles, engineer equipment and unit movement on the battlefield will be further developed in support of combat vehicle development and terrain intelligence

applications. Criteria for rapid construction of approach roads to tactical bridges through soft ground and for construction of bridge abutments and piers, building foundations, etc. using soil confinement principles will be developed.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Research is conducted in the areas of weapons effects and protective structures, lines of communications and mobility engineering, and geoscience techniques and methodologies. Specific objectives are: to provide the Army a capability to predict basic explosion effects and response of military targets to nuclear and conventional munitions; to develop design and operational criteria for field fortifications, and design criteria and construction techniques for underground hardened facilities needed by the Army; to develop improved methodologies for predicting the performance of combat vehicles, engineer equipment, and combat units on the battlefield; to develop, improve and apply engineering technology for lines of communication facilities and military airfield pavement systems; and to develop techniques and criteria for determining the physical properties and response of earth materials important to engineering and construction activities.

F. RELATED ACTIVITIES: Program Element 6.11.02.A, Project AT22, Research in Soil and Rock Mechanics. The Navy, Air Force, Defense Nuclear Agency, Defense Civil Preparedness Agency, Department of the Interior, Department of Transportation, and the Department of Energy have related mission-oriented research. Formal coordination is through annual technical reviews, the Joint Services Civil Engineering Research and Development Coordinating Group and joint interagency activities. Informal coordination is through frequent individual contacts.

G. WORK PERFORMED BY: Approximately 83 percent of the work is performed in-house. The US Army Engineer Waterways Experiment Station, Vicksburg, MS, serves as the managing laboratory and is the primary performing activity. A portion of the work in the weapons effects and protective structures area is performed by the US Army Construction Engineering Research Laboratory, Champaign, IL. Contractors to be selected through Request for Proposals.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Guidelines for destruction of bridges by explosion-produced water columns and for prediction of damage to bridge piers from contact munition detonations were formulated. Design criteria for buried fabric-covered shelters and for earth cover systems to withstand the effects of high-explosive munitions were devised and verified. Techniques of design include prediction capabilities for cratering, ejecta, airblast and ground shock was made operational. Criteria for improved emplacements to protect the dismounted and mounted tube-launched, optically-tracked, wire-guided antiarmor missile and crew from the effects of conventional weapons were formulated. A computer-based methodology to analyze the field Army's bridging requirements in the 1980's was developed. A first generation computer-aided terrain mobility

analysis procedure was developed in support of a new major thrust in making a quantum improvement in generation of timely terrain intelligence.

2. FY 1978 Program: Improved doctrine relating to subsurface explosions and their effectiveness against surface and underground structures will be formalized and documented in proper format for inclusion in Army field manuals. Additional prediction methods will be added to the computerized weapons effects information and analysis system. Field experiments to produce antitank ditching designs for use in support of US Army Europe requirements using a commercial slurry explosive will be completed. Tests will be conducted to develop hardening and demolition criteria fo urban structures found in Germany. New techniques will be developed to meet current bridge access/egress requirements during tactical operations. Tests will be conducted on various grid systems and surfacings to stabilize beach sands for logistics over-the-shore operations. Ground vehicle mobility investigations will concentrate on field assessment of current computer-aided mobility terrain analysis procedures, on upgrading the single vehicle performance prediction model, and on finalizing model logic for predicting engineer equipment performance in forward battlefield areas. Work formerly conducted under Program Element 6.37.34.A, Project DT08, Military Construction and Field Engineering Development, on field validations and demonstrations for protective structures designs and lines of communications operational concepts will be continued in this project this fiscal year under the new technical area, Field Tests and Battlefield Performance Criteria. A final design for an improved air-mobile assault bunker will be validated and a method for selecting protective structures for various battlefield conditions will be formalized.

3. FY 1979 Planned Program: Concepts for using explosive excavation in support of armor and antiarmor operations will be formulated. The weapons effect information and analysis system will be updated and expanded. Criteria for the design and evaluation of field fortifications and hardened structures to defeat the effects of conventional weapons will be developed for use in military operations in built-up areas, in construction of hasty strongpoint defense positions, and in determining the vulnerability of troops and equipment of fuel-air munitions. Technology will be developed for the economical design of underground hardened command and storage structures to defeat the effects of nuclear and conventional weapons. Concrete of various types and densities for absorbing small arms rounds will be evaluated for use in training village construction for troop training in urban warfare. The single vehicle performance prediction model will be upgraded and first generation unit movement and engineer equipment performance models will be developed. A preliminary mobility-oriented terrain data base will be devised. Criteria for rapid construction of approach roads to tactical bridges through soft ground and for construction of bridge piers and abutments made from confined soil will be formulated. An airfield pavement response prediction model and an airfield pavement joint design will be developed for input into a new overall airfield pavement analysis method. A capability to repair and rehabilitate roads and storage areas and new methods for rapid acquisition of meteorological data in theaters of operation will be formulated. Validation tests will be conducted on a fiberglass-reinforced plastic buried sheleter to be used as an inexpensive ammunition storage bunker. In-house personnel engaged in program; 50 professional, 54 support. The $1060 thousand increase in funding for FY 1979 is to capitalize on a rapid breakthrough in ground mobility technology ($650 thousand); to improve Army capability of doctrine for successful military operations in built-up areas ($300 thousand) and

battlefield hydrology ($110 thousand).

4. FY 1980 Planned Program: The vulnerability of concrete/masonry dams to the effects of nuclear weapons will be determined. The weapons effects information and analysis system will be updated to reflect additional field test data. Tests of hardening and demolition materials and techniques will be conducted using urban buildings. Response of structures to fuel-air munitions will be determined. Technology for predicting the response of protective structures to large high-explosive rounds will be formulated. Criteria for using commercial explosives to accomplish a variety of military missions will be evaluated. Applicable grid confinement systems for stabilizing sand in over-the-shore operations will be defined. Development of pier modules for use in military container ports will begin. The mobility-oriented terrain data base will be expanded. The single vehicle, engineer equipment and unit movement models will be improved an field tested. Field tests will be conducted of proposed methods and materials for camouflage of fixed installations and for rapid acquisition and prediction of hydrologic data. Procedures for design of foundations on swelling soils will be finalized.

5. Program to Completion: This is a continuing program.

FY 1979 RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: 6.27.20.A Title: Environmental Quality Technology
DoD Mission Area: 1133-Environmental Quality Research and Development Budget Activity: 1-Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL PROGRAM ELEMENT	11720	7477	9448	10459	Continuing	Not Applicable
D048	Environmental Quality Research & Development	3000	2644	2892	3650	Continuing	Not Applicable
A835	Identification & Health Effects of Military Pollutants	5952	2660	3721	3974	Continuing	Not Applicable
A896	Environmental Quality for Construction & Operation of Military Facilities	2768	2173	2835	2835	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Program provides the exploratory development support to the Army's program to minimize the impact of Army activities on the environment. The objective of the Army program is to comply with Federal and State pollution abatement requirements without impairment of the Army's role in national defense. The three projects comprising the Program Element are performed by The Surgeon General (TSG), The Chief of Engineers (COE), and the Development and Readiness Command (DARCOM) with each developing agency focusing on mission related research efforts. TSG (Project A835) conducts health and environmental effects research; COE (Project A896) is concerned with the development of techniques for pollution abatement at mililtary installations and DARCOM (Project D048) deals with pollution abatement of Army munitions plants, depots and arsenals. The major program thrust is to provide the technology base to enable the Army to meet 1984 and beyond pollution abatement standards. The program is and will be responsive to the science and technology objectives stated for environmental quality in the Army Science and Technology Objectives Guide (STOG) for FY 1978, 1979 and 1980.

C. BASIS FOR FY 1979 RDT&E REQUEST: The funds requested in FY 1979 will permit continued exploratory development of processes for recovery/reuse or treatment and disposal of munitions/explosive manufacturing wastes; studies of the environmental effects of munitions wastes leading to establishment of realistic environmental standards; the development of improved procedures for assessment of the environmental impact of Army actions and the development of new disposal/treatment and mitigation methods for pollutants generated at military installations.

Program Element: #6.27.20.A Title: Environmental Quality Technology
DoD Mission Area: #133-Environmental Quality Research and Development Budget Activity: #1-Technology Base

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Program was initiated in 1973 to consolidate and better coordinate fragmented environmental quality exploratory development activities within the Army. The program is aimed at providing cost effective technology in support of the Army's program to achieve compliance with pollution abatement and environmental enhancement requirements with respect to its industrial plant and military installation operations. The technical thrust areas of the progam are: Environmental and Health Effects Research aimed at developing a data base of mammalian, aquatic and vegetative chronic and acute toxicity information on the unique chemical wastes resulting from Army munitions plants and other pollution sources; Environmental Monitoring, Management, Assessment and Planning Technology to provide effective methods, procedures and systems for measuring and identifying pollutants, assessing environmental impacts of planned actions and information data bases for effectively performing management and planning functions with appropriate consideration of environmental protection and enhancement; Source Reduction, Control and Technology to provide a technology base of methods, processes and systems to enable the Army to deal effectively with the pollution problems at its industrial facilities and military installations.

F. RELATED ACTIVITIES: Projects AH68 Process Pollution Abatement Technology, and BS04 Indentification and Health Effects of Military Pollutants, comprise the basic and applied research potion of the Army Environmental Quality Technology Base Program. Project AH68 is concerned with gaining an understanding of the fundamental chemical/physical processes that can occur during treatment/disposal of munitions wastes; Project BS04 is concerned with investigating the feasibility of developing less costly and time consuming methods for conducting toxicology studies. Program Element 6.27.20 provides technology transfer to the pollution abatement portions of the Military Construction, Army (MCA) and the Operation and Maintenance, Army (O&MA) appropriations. The Air Force and the Navy have environmental quality research efforts directed toward satisfying their specific mission needs. In areas of common service interest, joint efforts are undertaken or a service may adopt the results of another service's research. The services' environmental quality research activities are monitored by Department of Defense through annual budget/apportionment reviews and periodic Topical Reviews on program areas of tri-service interest. At the service staff level, semi-annual meetings of the Joint Civil Engineering Research & Development Coordination Group (JCERDCG) enables coordination of technical programs among the services. Service Coordination is further enhanced through the DOD Area Coordination Paper Nr. 42 on Environmental Quality Research and Development. This document is periodically revised through tri-service coordination. Inter-Service coordination also occurs routinely at the technical level on joint programs and other programs of mutual interest. Other federal agencies also pursue environmental quality research programs related to their roles in the federal government; these are: The Environmental Protection Agency (EPA), the Department of Health, Education and Welfare (HEW), Department of the Interior (DOI), National Aeronautics and Space Administration (NASA), Department of Agriculture (DA), the Department of Energy (DOE), Department of Transportation (DOT) and the Department of Housing and Urban Development (HUD). Coordination with these agencies is undertaken at the technical level to avoid duplication and in areas of mutual interest, joint programs are undertaken.

G. WORK PERFORMED BY: Approximately 58% of the research effort is performed in-house by the U.S. Army Armament Research &

Development Command, Aberdeen Proving Ground, MD; Natick Research and Development Command, Natick, MA; Mobility Equipment Research and Development Command, Fort Belvoir, VA, Test and Evaluation Command, Dugway Proving Ground, UT, Electronics Research & Development Command, Fort Monmouth, NJ, U.S. Army Medical Bioengineering Research Laboratory, Fort Detrick, MD, Construction Engineering Research Laboratory, Champaign, IL, Waterways Experiment Station, Vicksburg, MS, and Cold Regions Research and Engineering Laboratory, Hanover, NH. Contractor to be selected at later date.

E. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Program objectives and priorities were initially established in FY 1977 by the Army Science and Technology Objectives Guide (STOG). Science and technology objectives for the environmental quality technology program addressed needs for improvements in the technical areas of environmental and health effects research; environmental monitoring, management, assessment and planning technology and environmental pollution source reduction, control and treatment technology. Accomplishments in these technical areas have included: establishment of temporary environmental and health effects guidelines for six priority munitions waste compounds and the initiation of studies on 58 other munitions related, Army-unique compounds; development of a computer system for aiding preparation and review of environmental impact assessments and statements; development of field survey techniques for pollution detection and analysis; development of munition plant pollution monitoring devices; development of a low polluting, more effective process for purification of Trinitrotoluene (TNT) and a process for removal of explosive wastes from munitions plant waste water. Manpower utilized in FY 1977 consisted of 81 professional and 21 support personnel.

2. FY 1978 Program: A substantial fund reduction in FY 1978 caused the elimination of planned efforts in support of occupational health in Army munitions plants, field Army wastewater reuse systems and field methods for production of potable drinking water. Research is being continued in priority mammalian and aquatic toxicity studies and chemical characterization of waste water and air emissions from munitions plants. The pilot process design for the low polluting TNT purification process will be completed and evaluation initiated. Investigations are being completed on a new technique for recovery and recycle of pollutants resulting from explosive manufacture. Investigations are being continued to evaluate feasibility of several potentially promising methods for chemical/physical processes for controlling/treating munitions wastes. Efforts are also being continued toward completion of the computer aided environmental impact assessment capability and completion of a manual for prediction of blast noise from training activities at military installations. The manpower required to accomplish the FY 1978 program includes 80 professional and 20 support personnel.

3. FY 1979 Planned Program: The increase in funds for the FY 1979 planned program reflects a re-establishment of the program level of effort prior to the FY 1978 fund reduction. Of the $1,971,000 increase, $1,061,000 will be used for initiating chemical characterization and toxicity studies on additional waste compounds resulting from munitions manufacture; $248,000 will be used for initiating additional munitions waste reduction/reuse technology developments and $662,000 for additional work on environmental impact assessment procedures and economic impact forecasting methods. In addition, the development of

criteria for TNT related water pollutant standards will be completed and toxicity studies of other munitions waste compounds will be continued. Development efforts on munitions waste source reduction and control will also be continued with emphasis on seeking alternatives to incineration of propellent, explosive and pyrotechnic (PEP) wastes and PEP contaminated materials. Studies will be completed on the use of powered carbon and methods for recovery and reuse of carbon employed in explosive manufacturing. Also in FY 1979, integration of the various subprograms comprising the computer aided environmental impact asessment system will be completed and field testing initiated. Efforts toward combining blast, helicopter and vehicle noise prediction will be continued to provide an integrated installation noise contour capability. The anticipated manpower requirement for the FY 1979 progam included 64 professional and 32 support personnel.

4. FY 1980 Planned Program: Priority emphasis will be continued on standards development for munitions wastes and develpment of technology for munitions waste source reduction, control and treatment. Mammalian and aquatic toxicology studies will be completed on two munitions wastes as will studies on uses for explosive wastes. In addition, completion of efforts on integration of the computer aided environmental impact assessment capability will enable additional efforts to be placed on development of analytical models for air and water quality impact prediction to provide greater flexibility and accuracy in environmental impact prediction. Manpower requirements for accomplishing the FY 1980 program include 95 professional and 28 support personnel.

5. Program to Completion: Priority efforts are expected to continue through 1984 to complete ongoing munitions waste standards and the munitions waste source reduction, control and treatment technology development. Continuation of the program beyond 1984 is anticipated in order to posture the Army for meeting future, more stringent, pollution control requirements expected to be established by federal and state regulatory agencies and to support environmental quality requirements imposed by status of force agreements with foreign governments.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.22.A
DoD Mission Area: #132 - Training and Personnel Technology

Title: Army Training Technology
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3548	4000	5186	4354	Continuing	Not Applicable
A764	Training and Education	2318	1314	1651	1486	Continuing	Not Applicable
A765	Human Factors in System Development and Operations	1230	1314	1582	1420	Continuing	Not Applicable
A777	Individual Training Technology	0	1372	1933	1468	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: In order to improve combat readiness, the Army must develop a technology base for improving individual and unit proficiency and effectiveness of selected military systems. Such improvement can be achieved through advances in training methods and training systems, performance specification and assessment, establishment of operator needs for man-machine interface, integration of personnel with equipment and missions, and improvement in work procedures. Part of the research included in Project A764 has been transferred to Project A777 beginning with FY 78.

C. BASIS FOR FY 1979 RDTE REQUEST: Provide exploratory development (in support of advanced development in Program Element 6.37.43.A, Training and Utilization in Military Systems to maintain combat readiness via (a) improved operating procedures for existing and new systems, (b) evolving training technologies, e.g., computer training and the use of simulators and simulations as an effective means of improving performance but with reduced hazards, fuel and ammunition costs, and (c) refresher training to minimize critical skill loss in operational units.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Project A764, Training and Education, provides support to development of predictive models of training device and media effectiveness; simulations for training of command group personnel and teams; job performance based measures for evaluating weapon crew and tactical unit proficiency; extension of engagement simulation techniques for combat unit effectiveness analysis to include laser technology and expansion to additional combat situations (e.g., air to ground) and to higher unit levels, (e.g., platoon and company); crew and team training for armor weapons systems; and flight simulation requirements for optimizing flight training programs. Project A765, Human Factors in Systems Development and Operation, provides mission-oriented support to development, assessment, and application of improved doctrine, work methods and system design concepts for enhanced user performance in military systems. Focus is on more effective utilization and extension of human abilities in processing and utilization information, control and management of system resources, and in configuring organizational and system elements. Project A777, Individual Training Technology, provides base for developing more effective individual job training, more valid

measures of job performance and training program effectiveness, better models for predicting learning and retention of skills, and more direct information feedback systems to relate field performance to instructional system requirements.

F. RELATED ACTIVITIES: Program Elements, 6.37.43.A, Training and Utilization in Military Systems; 6.27.57.N, Training and Human Engineering Technology; 6.22.05.F, Training and Simulation Technology. Interservice coordination is assured through Department of Defense monitored topical reviews, annual budget and apportionment reviews, all-service participation in the development of the tri-service Technology Coordinating Papers, and participation on tri-service committees in such areas as educational technology, training simulation human factors in operational testing and aviation crew performance.

G. WORK PERFORMED BY: Perceptronics, Woodland Hills, CA; Human Resources Research Organization, Alexandria, VA; Applied Psychological Service, Wayne, PA; Applied Science Associates, El Paso, TX; Martin-Marietta Corp., Orlando, FL. Other contracts will total about $900 thousand. US Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA (in-house).

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Accomplishments contributed to such Army programs and missions as team unit training, helicopter flight training, engagement simulation training for combat, tactical communications, tank system training, gunner training, and skill qualification testing. Accomplishments included products identifying behavioral requirements of common jobs, new laboratory facilities that reduce hazards of training, scenarios for engagement simulation, development of new training facilities. Specific examples follow: A team training facility at Ft Gordon combined computer graphics courseware and software at one time to train team members to function as a team. Rotary wing pilot performance standards established to distinquish performance differences to serve as a basis for training simulator development. A laboratory facility was developed to conduct night flight nap-of-the-earth helicopter research to eliminate hazards of actual flight. A new model determined how and what variables to sample for tactical communications engagement simulation training. Training structure for the M48A5 tank system was developed for cadre training. Tactical scenarios were created and validated for use in combat developments testing for two-sided free play engagements of unit-sized forces. Techniques were developed for conducting field assessments of tactical training programs and for establishing degradation rates for critical combat skills in the US Army Europe environment. New gunner procedures which improved live fire performance developed for air defense artillery were developed. Techniques were developed to guide constructors of Skill Qualification Tests in the field in the expansion of this program to additional combat and combat support jobs. Feasibility of using a catalogue of knowledges and skills to identify behavioral requirements underlying common job tasks was demonstrated.

2. FY 1978 Program: Laboratory evaluation of adaptive computerized training technique for teaching electronic troubleshooting skills. Conduct of analysis of Warsaw Pact nations military organization, weapons composition, equipment and tactics directed towards development of realistic opposing force scenarios for engagement simulation training. Evaluation of reduced data collection techniques model and development of data base on tactical skill decay collection techniques model during an Armor/Anti-Armor/Combined Arms test. Development of data base on tactical skill decay rates in the United States Army Europe setting. Establishment of objective methodology for allocation tactical information collection assets to satisfy prioritized requests. Development of model of tactical symbology combining military needs and functions, operator needs and characteristics, and new display technology. Design of system to reduce operator error in which the operator calls for information and the computer guides

him in a computer-moderated exchange. Establishment of operator requirements for light-attenuating devices (goggles) to permit simulation of night luminance levels during daytime thus reducing hazards of night operations training. Development of analytic techniques to determine, specify and match job performance needs and skills. Determine requirements for visual simulation display systems for rotary wing pilot performance research. Determine training effectiveness of an experimental training program and prototype Conduct of Fire Trainer in Armor One-Station-Unit Training. Development of diagnostic gunnery performance assessment procedure. Design of a prototype training delivery system for maintenance jobs.

3. FY 1979 Planned Program: Develop prototype Army Training and Evaluation Program for tactical data systems operators working as a team wherein the total operational system is used as the training device. Develop critical decision-making skills of small unit, combat arms leaders during engagement simulation. Develop a Warsaw Pact nations scenario for more realistic engagement simulation training. Develop skill acquisition curves of unit tactical skills for engagement simulation training with the Multiple Integrated Laser Engagement System. Continue determination of requirements for visual simulation display systems for rotary wing pilot performance research. Develop training techniques, including the use of simulators for retention of flight skills of helicopter aviators in operational units. Continue development of a diagnostic gunnery assessment procedure. Develop a training program structure for the advanced tank systems (M60A3 and XM-1). Develop a model of organizational factors in command and control to assess functional relationships among staff elements and personnel and potential impact of doctrinal changes on the Tactical Operations Center configuration and training. Continue development of analytic techniques to determine, specify, and match job performance needs and skills. Validate a prototype training system to improve performance of maintenance jobs. Identify technology gaps in methods to predict impact and tradeoffs of such factors as environmental conditions, personnel skill levels and the allocation of functions to man or machine. The total number of employees financed with requested FY 79 funds is in-house - 60 professionals, 14 support personnel, contract - 54 professionals and 3 support personnel. Increased funding is required to expand technology development for the ultimate benefit of individual and unit training and evaluation in the complex operational environment.

4. FY 1980 Planned Program: Develop authoring tools for complex computer-based collective team training scenarios. Develop computer-based aids for information integration on the basis of human pattern perception and information use. Determine implications for training and doctrine based on engagement simulation exercises utilizing the Warsaw Pact scenario developed previously. Continue development of training techniques including the use of simulators for retention of operational unit aviator flight skills. Determine helicopter pilot display characteristics for craft movement, location and attitude to maintain aircraft orientation. Analyze human performance in air defense systems relating performance variables with hardware characteristics to reduce equipment design problems. Continue development of a training structure for the advanced tank systems (M60A3 and XM-1). Evaluate the organizational factors model in command and control for assessing functional relationships among staff elements and personnel and for providing input for doctrine, configuration and training for the Tactical Operations Center. Develop and validate a general skill decay regression model. Develop and test procedures to objectify costs and benefits for training and selected weapons systems. Develop general methods for forecasting and allocating training resources for new combat systems in the RDTE chain.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.23.A
Title: Clothing, Equipment and Packaging Technology
DoD Mission Area: #131 - Medicine and Life Sciences
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2276	3025	3450	3930	Continuing	Not Applicable
AH98	Clothing and Equipment Technology	1922	2715	3085	3380	Continuing	Not Applicable
AH98-A	Clothing and Equipment	1075	1652	1935	2070	Continuing	Not Applicable
AH98-B	Vulnerability Protection	155	180	0	0		Not Applicable
AH98-C	Materials	692	883	1150	1310	Continuing	Not Applicable
A427	Tactical Rigid-wall Shelters	354	310	365	550	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Exploratory development (ED) efforts in this program are oriented to correct mission deficiencies in combat clothing, individual equipage and support equipment in order to increase the soldier's effectiveness and provide protection for him against battlefield hazards and the natural environment. Clothing is needed to provide comfort for both normal and extreme climatic conditions and, in specific cases, to provide camouflage, ballistic protection, chemical protection, and flame and fire resistance. To counter future weaponry and surveillance systems, reliance must be placed in considerable measure on the improvement of materials or the creation of new ones. For example, new synthetic fibers of unusual protective power can be predicted, and new dyes and weave patterns can be expected to provide passive defensive protection against all modes of enemy surveillance. ED in tactical rigid-wall shelters is part of a Department of Defense effort to meet International Organization for Standardization (ISO) requirements and halt the proliferation of tactical shelters and special purpose vans within the system. ED in field tentage will correct deficiencies in current tentage by providing a family of general purpose field tentage which provides mobility, habitability, and unobstructed floor space. Work on organization field service equipment is to decrease cost of operation while improving efficiency.

C. BASIS FOR FY 1979 RDTE REQUEST: To conduct relevant research pertaining to the development and improvement of fibers, fabrics, materials, new design applications, camouflage (dyes and technology) for clothing, personnel equipment and field service support equipment to increase the survivability of the combat soldier on the battlefield against the projected threats. Payoff is in maintenance of an in-house expertise and capability to capitalize on new industrial developments and convert them to military use.

Program Element: #6.27.23.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Clothing, Equipment and Packaging Technology
Budget Activity: #1 - Technology Base

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This program element (PE) is designed to increase human performance, environmental protection, and personal comfort; reduce the weight of soldier's clothing and equipment; upgrade levels of protection against chemical agents, flame, and fragmentation threats; investigate countermeasure systems that provide camouflage of the individual soldier against electro-optical devices; and explore the use of new materials and designs to protect the eyes against nuclear flash, laser, and ballistic threats. Also included are studies to improve field service equipment, field life support facilities, tactical rigid-wall shelters, and the development of design criteria for field shelters.

F. RELATED ACTIVITIES: Related research is conducted by coordination with each of the other Services who develop their own Service-related clothing and individual equipment items. Coordination and liaison with industry is accomplished by the US Army Natick Research and Development Command personnel. The exploratory development (ED) efforts in clothing and equipment move to advanced development (AD) under PE 6.37.47.A, Soldier Support/Survivability, and to engineering development under PE 6.47.13.A, Combat Feeding, Clothing and Equipment. AD in tactical rigid-wall shelters is performed in Project D428, Tactical Rigid-wall Shelters of PE 6.37.26.A, Combat Support Equipment. Engineering development is conducted in Project D429, Tactical Rigid-wall Shelters of PE 6.47.17.A, General Combat Support.

G. WORK PERFORMED BY: In-house efforts are performed by the US Army Natick Research and Development Command (NARADCOM), Natick, MA, and US Army Research Institute for Environmental Medicine, Natick, MA. Potential contractors include: Lehigh University, Bethlehem, PA; Fabric Research Laboratory, Dedham, MA; Brunswick Corp., Marion, VA; and Parsons Co., Stockton, CA. Value of contracts is $300,000.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Clothing and equipment technology efforts included completion of engineering development (ED) of the following representative items: tropical combat uniforms; heated handwear; flame protective clothing; improved designs for personnel camouflage; and experimental helmet and personnel body armor prototypes. Commercial materials and items containing various insulating materials having potential for use in uniforms for a cold/dry environment were evaluated and compared to in-house developed experimental items. Preliminary work was conducted on an individual cooling system for combat vehicle crewmen, helicopter pilots, operators of heavy equipment, and special mission personnel. Recoloring formulations were adopted for camouflage of the TOW-CAP (ballistic cover for tube launched, optically tracked, wire guided missile) and laminated helmet. A new coloration system was developed to replace olive drab canvas with a forest green color with controlled infrared reflectance. A survey on body sizes of Army women was completed. A device for eye protection against nuclear flash blindness was designed and constructed. Research showed that tents using air-pressure stabilized beams as structural members can be designed to meet snow load requirements. Systems analysis concepts for a new generation of modular general purpose tentage were completed. Ballistic impact tests of single nylon 6-6, Kevlar 29, and Kevlar 49 yarns were conducted.

Program Element: #6.27.23.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Clothing, Equipment and Packaging Technology
Budget Activity: #1 - Technology Base

2. FY 1978 Program: Investigate the upgrading of current chemical protective materials by development of improved charcoal binders and formulations, investigate different fabrication procedures, and substitution of less costly materials; continue ballistic protective studies by measuring experimental transient deformation of yarns; design and utilize chelate systems to generate information on thermal properties, coordination chemistry, and structure; continue to study novel porous sheets as possible replacements for woven and knitted fabrics; synthesize and select candidate photochromic materials for incorporation into flash blindness protective field devices; and continue studies to define and develop method of construction of tactical rigid-wall shelters to include developing the understanding of stress distribution in shelter structures to optimize computerized design.

3. FY 1979 Planned Program: Continue exploratory development (ED) of: fibers and fabrics for chemical protection by procuring activated carbon yarn for prototype application and fabric which has been treated to prevent sweat poisoning as well as seeking alternative ways to prepare yarn; evaluate yarns combining different fiber types to determine how ballistic response can be optimized by piled yarn construction; continue development of experimental techniques to assess wet and dry thermal insulation resistance; continue analytical and experimental studies to determine optimum material design and configuration for protective clothing to minimize heat loss; use heat flow meters, colorimeters, differential thermal analysis (DTA) and other sensors to determine the effectiveness of various polymeric systems against different thermal sources; continue study to provide the technology base for objective methods of shade acceptance, color grading and definition of tolerances for shade evaluation; initiate efforts to reduce weight of clothing items using microfiber, lightweight polyurethanes and vapor permeable/water-resistant materials; continue research formulations of colorants that possess luminescence properties similar to nature; investigate possible use of photochromic systems in laser eye protection; continue studies in the mechanics of tentage material and structures and in field service equipment; and evaluate methods of joining/interconnecting tactical rigid-wall shelters and moving tactical shelters short distances for integrating functions in the field as well as continuing to develop hardware and/or materials for tactical shelters.

4. FY 1980 Planned Program: Continue the study of increased sorptivity/reactivity of grafts on activitated carbon; evaluating fibrillated composites with activitated carbon and seeking new sorbents to replace activated carbon; initiate analysis of terrain characteristics for reflectance and spatial frequencies to provide objective basis for design of camouflage patterns; refine system for suppression of infrared (IR) thermal signature; initiate study of means to combine suppression of radar and IR thermal signature of personnel; study energy absorption properties of thin foam materials for bump/impact protection of combat vehicle crewmen; continue to study the response of materials to high energy sources by preparing chelate or similar polymers with high heat stability and minimal smoke formation; continue to evaluate novel porous sheets in end items to replace woven fabrics; evaluate ballistic performance of various numereal multilayers; combining homogenous or inhomogenous plies of fibrous materials to optimize ballistic resistance and reduce material costs; continue studies of photochemical process and rates of dyeing; continue as required studies on lightweight fabric systems, alternative structures and tentage design features; complete concept feasibility studies on alternative field heaters and field latrine/bath/laundry/waste disposal systems, and continue studies on tactical rigid-wall shelters underway in FY 1979.

5. Program to Completion: This is a continuing program.

FY 1979 PDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: 6.27.24.A
DoD Mission Area: 131 - Medicine and Life Sciences

Title: Food Technology
Budget Activity: 1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	9277	7969	8327	8850	Continuing	Not Applicable
AH99A	Analysis and Design of Military Feeding Systems	2851	3257	2281	2566	Continuing	Not Applicable
AH99B	Subsistence Technology	3382	2717	2868	3606	Continuing	Not Applicable
AH99C	Food Service Technology	672	15	40	263		
AH99D	Radiation Preservation of Food	2372	2982	3138	2415	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The individual soldier, sailor and airman's safety, effectiveness and survivability are paramount since they are the common denominator that ultimately wins the battle. Insuring a safe, wholesome and nutritious food supply is a basic responsibility of the Services under conditions of combat, emergency mobilization and peacetime training. This program provides for studies of food preservation methods, food packaging and protection, food storage, preparation and serving equipment, and overall food management, supply and service systems for the Army, Navy, Marine Corps, and Air Force; and is part of the Department of Defense (DOD) Food Research, Development, Testing and Engineering (RDT&E&E) Program managed by the Army for the DOD. Wholesome, nourishing food is critical not only to the maintenance of physical health and well being but is of very high morale value especially when operations are conducted in hostile and hazardous areas. The logistical resources required to support a highly acceptable food service system represent a significant portion of the total force, requiring a complex transportation, storage and distributing system; a labor intensive force with special skill requirements and a high degree of management attention to keep the system in order. The objective of this tri-service program is to streamline, to the maximum extent possible, the overall requirements of the Food System consistent with available, potentially available and projected food technology capabilities from the US and foreign food industry, supplemented with in-house developments where unique military food systems requirements cannot be met.

C. BASIS FOR FY 1979 RDTE REQUEST: This program consists of four technical areas as indicated in paragraph A. Project AH99A, Analysis and Design of Military Feeding Systems, provides for continued analysis and design of an Army and Marine Field Food Service System to include Marine Corps Base Camp Food Service operations, and Navy Food Service Operations Afloat. Project AH99B, Subsistence Technology, provides for continued development effort to increase storage life, maximize nutrient retention and consumer acceptability, reduce weight and volume of ration components; improve packaging systems which includes increased insect

resistance; design improved insect control measures for military subsistence warehouses; control microbiological hazards in prepared stored foods; and determine means of reducing spoilage of fresh fruits and vegetables. Project AH99C, Food Service Technology, provides for equipment development and feasibility studies to support the system studies listed above and exploratory efforts in heat transfer for improved cooking/baking methods. Project AH99D, Radiation Preservation of Foods, provides for continued development of irradiated food preservation technology and support to the wholesomeness feeding tests of irradiated foods.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This program includes the exploratory development projects and requirements conducted by the Army as executive agent for the Department of Defense (DOD) Food Research, Development, Testing and Engineering (RDT&ENG) Program for all the Services and the Defense Supply Agency as described in DOD Directive 1338.10 and DOD Manual 1338.10. Food service logistics in support of combat operations is characterized by the requirement for transportation of large volumes of relatively lightweight material, some of which requires special handling (i.e., controlled temperature transportation and storage); special packaging for protection from the environment, insects, rodents, microbiological contamination, and less than optimum handling in the combat zone, and labor intensive operations requiring special skills in the final preparation and serving steps. The maintenance of the current Food System has been required to provide a level of food quality unattainable through the use of packaged "ready to eat" operational rations alone. The experiments, tests, analysis, design and feasibility studies in this program have the ultimate objective of reducing this logistical burden while maintaining an undiminished level of soldier, sailor, and airmen food acceptance. Exploration of alternatives to current practices include maximizing the use of labor using more productive equipment in the field, minimize skill requirements by use of fully prepared "convenience type" foods, minimize transportation weight and space requirements by food dehydration and compression techniques, increased storage stability to reduce costs of maintenance and rotation of prepositioned war reserve stocks, and reduce requirements for critical materials in packaging. Consideration of packaging disposability problems in the combat zone. Special emphasis is placed on the food storage space limitations in Navy ships to decrease frequency of replenishment and increase mission length. While the primary emphasis in this program is combat support oriented, collateral efforts to reduce DOD garrison (fixed) dining facility costs are also conducted.

F. RELATED ACTIVITIES: Work conducted in this program is part of the DOD Food RDT&ENG program which also has projects in the following areas: Program Elements 6.11.02.A, Project AH52, Basic Research in Support Equipment for the Individual Soldier; 6.37.47.A, Project D610, Food Advance Development; 6.47.13.A, Project DL47, Wholesomeness Testing of Irradiated Foods; and 6.47.13.A, Project D548, Military Subsistence Systems.

G. WORK PERFORMED BY: The majority of effort is conducted by the US Army Natick Research and Development Command, Natick, MA. Other Army and government laboratories providing assistance are the Letterman Institute of Research, Presidio of San Francisco, CA; The Construction Engineering Research Laboratory, Champaign-Urbana, IL; and the Regional Laboratories of the Department of Agriculture. Also various colleges and universities perform work in this program such as University of Nebraska, Lincoln, NB; Bowling Green University, Bowling Green, OH; Massachusetts Institute of Technology, Cambridge, MA; Boston University,

Boston, MA; Michigan State University, E. Lansing, MI; and Ohio State University, Columbus, OH. Potential representative commercial contractors are Data Control Corporation, Falls Church, VA; Battelle Columbus Laboratory, Columbus, OH; Reynolds Metals, Richmond, VA; Springborn Laboratory, Enfield, CT; Clevepak Corp., White Plains, NY; Pennwalt-RM Corp., King of Prussia, PA; Shankman Laboratories, Los Angeles, CA; and International Paper Co., Tuxedo Park, NY.

B. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Potential storage life of packaged combat rations and meal components has been increased by processing methods which reduce oxidation and other deteriorative processes; techniques for preservation of meat by irradiation were greatly improved; completed the definition of a modernized system for establishing and administering the basic daily food entitlement for enlisted members of the Department of Defense which included a proposed uniform ration law to replace the outdated Federal Statute of 1933; completed an evaluation of Navy Commuted Rations ashore/a la carte system which resulted in rejection of this system due to negative impact on nutrition; Navy Food Service Training Study resulted in recommendations for more efficient food service training which have a potential for $630 thousand annual savings; preliminary results of Army field feeding study identified a potential for annual savings of $5 million per division by reducing food service personnel requirements by 40 percent; established microbiological criteria to insure Air Force missile site food quality; completed prototype of an untended device for storing/heating/dispensing food at missile sites; developed product/process parameters for new reversably compressed foods and demonstrated a potential for new freeze drying techniques that reduce process time and cost.

2. FY 1978 Program: Continue storage, stability, processing techniques and human acceptance studies of new and modified subsistence items and rations; initiate analysis and design of an Air Force Food Service Mobilization Concept; continue analysis and design of Field Food Service for the Army and Marines; continue development of space saving foods for nuclear submarines; investigate feasibility of an intensive agriculture unit (based on hydroponics) for Navy; continue exploratory development for a Marine lightweight assault Food Packet and an improved Air Force Inflight Food Packet; complete development of an integrated Air Force base food service system; continue analysis of Army Hospital feeding; continue analysis of Marine Corps base food system; continue studies on insect proof packaging; continue design and analysis of Navy Food Service System Afloat; develop improved subsistence warehouse insect control measures; continue missile site microbiological quality control procedures and complete development of a procedure for rapid field detection of microbial contaminants in missile site food; continue improvement of flexible packages for thermo processed foods and prototype development of new foods in multi-serving and flexible containers; continue basic studies of cooking/baking heat transfer methods, and initiate studies of causes of spoilage in fresh fruits and vegetables.

3. FY 1979 Planned Program: Continue storage, stability, processing techniques and human acceptance studies of new and modified subsistence items and rations; complete analysis and design of an Army and Marine Field Feeding System; continue analysis and design of an Air Force Food Service Mobilization Concept; continue development of the Marine lightweight assault food packet; continue analysis and design of Army Hospital Food Service System; complete analysis of Marine Corps Base Food

Service System; continue insect resistant packaging studies; continue design and analysis of Navy Food Systems Afloat; complete development of chemical dispersal system for subsistence warehouse insect control; complete microbiological studies of missile site food quality; complete development for control of insects in storage where fumigation is not possible; continue studies of basic cooking/baking heat transfer methods; continue development of improved flexible packages and multi-serving containers to include prototype food items; and continue to survey causes of spoilage in fresh fruits and vegetables.

4. FY 1980 Planned Program: Continue storage, stability, processing technique and human acceptance studies of new and modified subsistence items and rations; continue analysis and design of Air Force Food Service Mobilization System; complete analysis and design of Army Hospital Food Service System Operations; continue studies on insect resistant food packaging; continue analysis and design of Navy Food System Afloat; develop improved food packaging methods consistent with current handling and storage techniques; continue development of multi-serving packages and food item prototype development; and continue cooking/baking equipment studies.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.25.A
Title: Computer and Information Sciences
DoD Mission Area: #127 - Information Processing and Display
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2100	2009	2510	3000	Continuing	Not Applicable
AT11	Engineering Software	200	200	250	300	Continuing	Not Applicable
DY10	R&D in Multicommand Data Systems	1800	1609	2085	2500	Continuing	Not Applicable
A778	Use of Behavioral Sciences in Computer Software R&D	100	200	175	200	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports the Defense System Software Research and Development Technology Plan promulgated in September 1977, and the Army Integrated Software Research and Development Program which was established in 1974. The objective is to conduct coordinated research in areas of the software technology base to permit the growth of Army software development from an art to a well structured discipline. Common software tools, techniques and procedures must be developed for use by a wide variety of application system developers and Project Managers, if the ever increasing costs of software development and maintenance are to be kept in check. Development of common transportable software tools will result in decreasing the amount of resources required to develop software programs. Standardizing and increasing the power of higher order languages will result in a reduction in numbers and types of programmers required to develop and support fielded systems, thereby decreasing development, maintenance, and training costs. The major thrust of this program is to develop and utilize advances in computer software for near-term cost and quality improvements for both DoD weapons and automatic data processing (ADP) systems. The program content is coordinated under the Joint Service R&D Technology Panel to the OSD Management Steering Committee for Embedded Computer Resources and as such is integrated, interlocking and responsive of DoD-wide deficiencies. The program is specifically focused to provide tools to enhance the capabilities and efficiency of programmers and Program Managers, establish standardization where viable and to explore advanced architecture. Some work on hardware peripherals is also included.

Program Element: #6.27.25.A
DoD Mission Area: #127 - Information Processing and Display

Title: Computer and Information Sciences
Budget Activity: #1 - Technology Base

C. BASIS FOR FY 1979 RDTE REQUEST: Research will be conducted on new concepts and methods for the development of generalized tools, techniques, and procedures required to satisfy the needs of computer software developers for standard multicommand data processing systems; and research in human factors aspects of computer software, and scientific and engineering applications will also be conducted. The objectives are to develop analytical tools and techniques to monitor and predict computer system performance, control resources, produce future interactive management information systems which employ networks, data base management systems, minicomputers and microprocessors. The primary goal is to develop tools and techniques to improve productivity of software development personnel and to increase software reliability; and participate in the Department of Defense (DoD) development of improved, standard programming languages.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Recent studies by the Army and the Department of Defense (DoD) have established that the development and timely delivery of software of adequate quality is a major problem in weapon systems development. A major defense program initiative is underway to define and implement new software policies and procedures. To make possible the successful implementation of these new policies and procedures, this computer information sciences and technology program will refine, evaluate, and apply advanced software tools and techniques and instill an engineering discipline with rigor similar to that characterizing hardware development programs. The products of this development support the objectives of the DoD Management Steering Committee for Embedded Computer Resources and will provide essential insight into the means to best implement the new policies incorporated into DoD Directive 5000.29, "Management of Computer Resources in Major Defense Systems." Under this program element, the Army's Integrated Software Research and Development (ISRAD) program was formulated and adopted in 1974. Subsequent programs have been coordinated under the Army ISRAD structure, and since 1976 under the DoD Software Technology R&D panel as well. Under the coordinated DoD Defense System Software R&D Technology plan twelve technological areas of effort will focus on technology for improved management of Army computer resources. Their purpose is to produce software development and management concepts for future Army program managers to achieve the least possible life-cycle costs. The eventual goal is to allow programmers to efficiently use support software that has been developed in the past. In FY 79 this function will be demonstrated for two separated and dissimilar computers.

F. RELATED ACTIVITIES: The ISRAD program receives support from Project 6.58.03.AM829 (Integrated Software). The Multicommand Data Systems project was transferred to this program element from PE 6.58.03.A (Technical Information Activities) in FY 1976. Efforts in this program have application to developments in the Army's Management Information Systems. Work previously planned by US Army Materiel Development and Readiness Command under this program element has been consolidated with related work in Program Element 6.37.01.A. Efforts in this area affect and are affected by the Army's cooperative endeavor with the DoD Management Steering Committee for Embedded Computer Resources, and other DoD panels/committees. Continued liaison at the laboratory level and between the US Army's Integrated Software Research and Development Program (ISRAD) Working Group and its Navy and Air Force counterparts minimize duplication of effort. Other Tri-Service's PEs which in total constitute the DoD Advanced Computer Science and Technology R&D Program are: Communications Electronics (62701A), Computer and Information Sciences (62725A), Automatic Data Processing Equipment Development (63703A) Integration of ARTADS (6.37.23.A), Command and Control Technology (62721H), Command, Control and Communications (62702F), Advanced Avionics (62204F), Distributed Information Systems (62706E), Advanced Computer Technology (63526H), Advanced Computer Technology (63728F), Computer Systems Engineering Development (64501H), and Application of Information Processing Technology (64740F).

G. WORK PERFORMED BY: International Business Systems, Washington, DC; General Electric Company, Arlington, VA; Georgia Institute of Technology, Atlanta, GA; Raven Data Processing, Washington, DC; Federal Data Corporation, Chevy Chase, MD. Additional FY 1979 contractors estimated to be 12 in number with dollar value $350 thousand. In-house developing agencies include: US Army Computer Systems Command, Atlanta, GA; US Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA; US Army Waterways Experiment Station, Vicksburg, MS.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Major accomplishments in Engineering Software project has included the following key efforts: Graphics Compatibility System (GCS) has been expanded to support three dimensions and has been implemented in a minicomputer environment supporting several time-sharing (T/S) users. Software to support low-cost shading and continuous tone color graphics has been developed. User base for GCS has been increased to over 50 local, state, and federal government (including DoD) installations. Finalized procedure for rapid computer reproduction and comprehensive editing of digitized data; defined and developed requirements for Army system of computer science software dissemination, and for the development of a common language for specification of data communication protocols. Major accomplishments in Multicommand Data Systems project (DY10) has included the following key efforts: Constructed simulation models of operations and maintenance phase of a typical computer system life-cycle to determine benefits obtainable from performance prediction; developed and demonstrated simulation models of various multicommand data systems; developed and transferred to the production environment generalized performance monitoring techniques to successfully reduce computer run time; developed tools to permit software performance prediction and optimization; determined design requirements and developed specifications for recommended Army Management Information System structure based on interconnected computers, data bases, and terminals; developed an

interactive programing capability; developed standards for and implemented structured programing in the production environment, also, published study of structure programing techniques; developed backend data base management system; conducted compatibility analysis of hardware environments, and specified portable subset of standard COBOL. Major accomplishments in Software Research (A778) has included the following key efforts: Designed and validated approach for creating transferable language interpreter software; performed human factors analysis of software development process and developed prototype job aids for planning, design, coding, validation, and modification of software; dapted psychological theory to programing tasks, and predicted program development performance based on propositional structure of programs; and expanded an existing transportable interpreter - Programming Language for Interactive Teaching (PLANIT) across different word sizes (24 to 16 bit) to minicomputer; and added PLANIT capabilities for graphic displays and team training (multiple interactive terminals).

2. FY 1978 Program: Software development concepts for future systems that will provide better information to Army managers at the least possible life-cycle cost will be developed. Research will be supported in new concepts and methods for the development of generalized tools, techniques, and procedures required to satisfy the needs of computer software developers for standard multicommand data processing systems, research in human factors aspects of computer software, and scientific and engineering applications. The key areas of research in Engineering Software project, is to implement a translator on remote job entry processors to demonstrate protocol transportability, and incorporate new technology into graphics capability. The key areas of investigation in Multicommand Data Systems projects, are to develop simulation techniques to represent minicomputer/Data Base Management System (DBMS), complete initial design of standard High Order Language (HOL), incorporate relational data base concept in back-end DBMS environment, and develop prototype tools for assessing test data quality. Standard DoD-Wide HOL Programming Language: Four languages are being developed in FY 1978. Competitive evaluations will be performed in late FY 1978 to select two for further development and final selection of one will be made in FY 1979. Software Management Methodology: The goal is to review and coalesce recent experience with software systems developments to provide guidance to the Program Manager as to lessons learned and problems to be avoided. Military Computer Family Architecture Standardization: The goal is to allow software developed for a tactical system to be used in future system hardware upgrading and also for other systems. The objective is to design a hardware architecture specification that permits widespread vendor competition, will be broadly applicable, and will permit future hardware advances to be incorporated. The requirements analysis will be completed in FY 1978.

3. FY 1979 Planned Program: Accelerate the use of new proven software advances by Program Managers and defense contractors. Within the Multicommand Data Systems project continue to develop and implement tools and techniques in the areas of portability, interchangeability, security/privacy, verification/validation, and programming languages; and extend the Data Base Management System concept to multicommand systems. The goal is to implement fullscreen interactivity and other graphic capabilities utilizing minicomputers. The eventual goal is to develop a portable operating system formally define standard HOL programming

languages, and develop a methodology for interactive specification of user requirements to produce the Detailed Functional System Requirement (DFSR), as well as the technical design of entire computer environment to support the users requirements. The Army Tactical Management Information System (TACMIS) test bed will be defined. This is a testbed to evaluate and demonstrate advanced software concepts established for tactical systems development, and to establish advantages and users acceptance. The key areas of investigation in the Engineering Software project are to develop and test generalized evaluation and validation programs and incorporate parallel and pipeline processing techniques into the graphics compatibility system which was initiated in FY 78. The key areas of investigation in the Use of Behavioral Science in Computer Software R&D Project are to develop methods for the measurement of programmer performances in human factor items, and develop on-line interface aids. Basis for FY79 budget change over previous year is due to: support of the DoD Higher Order Language Program (HOL), and support the Defense System Software Research and Development Technology Program/Plan.

4. FY 1980 Planned Program: Determine optimum graphics system architecture and cost/benefits ratios on different types of equipment. The eventual goal is to produce a comprehensive testing methodology which incorporates independently developed techniques. Another goal is to develop a prototype software quality measurement facility, develop a micro-monitor for improved system performance measurement, research scheduling algorithms, and investigate requirements specification languages to complement work in other user-oriented requirements areas. Software Management Methodology: In the later part of FY79 the US Air Force will complete a set of guidebooks, and in FY80 the Army and Navy will complete their modification of these guidebooks, which are tailored to their needs. Army Tactical Management Information System (TACMIS): The TACMIS testbed is scheduled for completion in FY80. The key areas of investigation in the User of Behavioral Science in Computer Software R&D project, is to develop human factors and design a guidebook for improved software production. In-house resources used to support this work in FY 1980 are 30 professional and 4 support personnel, and a very small investment in special facilities and equipment.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.26.A
DoD Mission Area: #124 - Target Exploitation

Title: Army Support of the Defense Advanced Research Project Agency (DARPA)
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	970	3000	3000	1500	0	8487
DH59	Army Support of DARPA HOWLS	485	1500	1500	0	0	3487
A557	DARPA Netted Radars	485	1500	1500	1500	0	5000

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This project funds the Army's portion of a joint DARPA-Army effort to investigate long term solutions to the hostile weapons location problem, and techniques for integrating, remoting and netting moving target indicating surveillance radars. The most promising approaches are incorporated into experimental hardware for test and evaluation. Hardware successfully demonstrated will become candidates for follow-on advanced and engineering development This project is needed to ensure that the most efficient methods are developed to locate hostile indirect fire weapons in both firing and non-firing modes; and to enable the Army to more effectively use ground and airborne radars to locate hostile targets without interruption.

C. BASIS FOR FY 1979 RDTE REQUEST: Complete the development of real-time solutions for airborne radar detection, classification and location of stationary targets and initiate demonstration of these techniques using existing experimental equipment. Complete the development of infrared (IR) guidance techniques in support of infrared autonomous terminal homing. Provide required technological support for the advanced development of the IR mortar locating system previously developed and successfully demonstrated under the HOWLS (Hostile Weapons Locating System) project, and transfer the technology to the Services. Netted Radar: Complete the development of the basic radar net using two (2) existing AN/PPS-5 radars modified to incorporate modern signal processing so that the direct automatic computer utilization of the radar's output is possible. Prepare for and demonstrate the netted concept at Fort Sill, OK. Complete development of a feasibility prototype netted radar. Continue development of advanced netting techniques. Major program milestones include:

MILESTONE	DATE
Netted Radar Concept Demonstration (Ft Sill, OK)	2QFY79
Complete Development of Feasibility Prototype Netted Radar	2QFY79
Demonstrate Upleg/Downleg Tracking of Projectile Tracking Radar	2QFY79
Complete Development of IR Guidance Techniques	4QFY79

Program Element: #6.27.26.A
DoD Mission Area: #124 - Target Exploitation

Title: Army Support of the Defense Advanced Research Project Agency (DARPA)
Budget Activity: #1 - Technology Base

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: In June 1973 the Defense Advanced Research Projects Agency (DARPA) was tasked by the Under Secretary of Defense for Research and Engineering (USDRE) to conduct a research and development program in search of new and improved solutions for the location of hostile indirect fire weapons in both firing and non-firing modes. DARPA invited the Army to participate in a cooperative five year program under DARPA lead and share the program cost. A Memorandum of Understanding (MOU) was signed in May 1974 which formalized the relationship between DARPA and the Army in the HOWLS program. This program is focusing on the use of small airborne radars; the application of a small, low cost infrared countermortar system; and fabrication of a dual frequency infrared sensor for homing on a hot weapon. Other areas undergoing varying degrees of investigation include: projectile tracking radars; electromagnetic emitters; airborne flash techniques; acoustic and seismic techniques; and other technology areas. DARPA is the primary source of funds for this program as the lead government agency. A Memorandum of Understanding was signed in September 1976 which formalized the Netted Radar program. This program will develop and demonstrate advanced radar technology for ground and air surveillance, to include processing, antennas, and mobile terminals.

F. RELATED ACTIVITIES: The primary service activities which complement this program are conducted by the Army in technology base efforts. These programs include: Program Element (PE) 6.27.03.A, Combat Surveillance, Target Acquisition and Identification; PE 6.27.09.A, Night Vision Investigations; and PE 6.27.32, Remotely Piloted Vehicle (RPV) Technology. There is a particularly close relationship with the weapons location activities in PE 6.27.03.A. A joint DARPA-Army steering group reviews all programs to insure there is no duplication and that the combined effort represents the best possible long term approach to weapons location. There is also a relationship between this program and Army work under: PE 6.37.04.A, Unattended Ground Sensors (UGS); PE 6.47.29.A, Countermortar Radar AN/TPQ-36; and PE 6.47.31, Counterbattery Radar AN/TPQ-37. These latter efforts will provide significant improvements in the near term, whereas the Hostile Weapons Locating System (HOWLS) is searching for longer range solutions to complement the radars and UGS.

G. WORK PERFORMED BY: Lincoln Laboratory, Lexington, MA, is the primary technical agent for the HGWLS and Netted Radar Programs. The US Army Electronics Research and Development Command, Ft. Monmouth, NJ is the lead service activity. The principle contractors are General Electric, Utica, NY; Martin Marietta, Orlando, FL; and Phillips Broadcasting Company, Mahwah, NJ.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAM:

1. FY 1977 and Prior Accomplishments: HOWLS: Project initiated in FY 1975. Designed and constructed experimental airborne radar system and initiated data collection supporting detection and classification technique development and analysis. Designed and constructed brassboard infrared (IR) mortar location system and successfully demonstrated concept; responsibility for follow-on development was transferred to the Army Night Vision Laboratory. Designed and built experimental two-color IR

sensor and completed ground-based measurement efforts supporting the analysis and acquisition technique development; initiated modification of the experimental sensor to permit airborne measurements and terminal homing seeker simulation. Completed measurements of flash, acoustic, seismic and radio frequency emissions of firing weapons. Work in flash and acoustics was terminated because other on-going programs were felt to deal adequately with these; seismic and radio frequency work was technically assessed as low pay off and also terminated. A study of projectile tracking radar alternative configurations was completed, and new trajectory determining algorithms were developed and tested; this work was applied to improve on-going service developments. Netted Radar: Project initiated in mid FY 1977. Selection of existing radars completed.

2. FY 1978 Program: Hostile Weapons Locating System (HOWLS): Complete investigation into basic airborne radar techniques and development of non-real time detection and classification algorithms; initiate implementation of real-time demonstration. Support Army Night Vision Laboratory in advanced development of infrared (IR) mortar location system. Conduct airborne measurements of two-color IR and complete comparison of alternative target acquisition techniques; initiate investigation of tracking techniques for terminal homing and experimental simulation of seeker. Complete projectile tracking radar work in trajectory algorithms and multipath compensation. Netted Radar: Complete development of basic net utilizing two modified AN/PPS-5 radars and prepare for demonstration of netting capability. Initiate development of feasibility prototype netted radar demonstration model. Initiate development of advanced netting techniques using data collected in early tests with basic two-radar set.

3. FY 1979 Planned Program: HOWLS: Complete development of real-time processing for airborne radar and conduct demonstrations. Complete support to Army Night Vision Laboratory in advanced development of IR mortar location system. Complete development of two-color IR guidance techniques and transfer this technology to the appropriate service development agencies (including Navy and Air Force). Netted Radar: Complete demonstrations of basic two radar net at Fort Sill, Oklahoma. Complete development of feasibility prototype netted radar and initiate into net. Continue development of advanced netting techniques.

4. FY 1980 Planned Program: Netted Radar: Complete development of advanced netting techniques and incorporate additional sensors and capabilities into experimental net. Application studies will be accomplished to assist in establishing the proper role for tactical radar nets within the Army. Promising techniques will be transferred to the Army for further development.

5. Program to Completion: Programs will be completed in FY 1980.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.27.A Title: Non-Systems Training Devices Technology
DoD Mission Area: #132 - Training and Personnel Technology Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2425	2050	1750	3540	Continuing	Not Applicable
A230	Non-Systems Training Devices	2425	2050	1750	3540	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: As the Army becomes more complex with an increase in sophisticated equipment and weapons systems the need for proper and effective training with these systems is accentuated. Costs associated with using actual equipment and live ammunition becomes prohibitive. Laser, electronic, and computer technology, however, have progressed in the simulation area where potential alternatives are possible. This program effort is directed toward conducting exploratory research and feasibility studies on their alternative technical approaches to assist in the selection of the most cost and operationally effective training devices and simulators to support the individual and unit training environments. This program will improve the "front-end" analytical effort and risk assurance which allow progression into Advanced Development. Development effort is applied to the following primary technical areas: Laser Simulation, Visual Simulation, Electronic Simulation, Maintenance Simulation and Electro-Mechanical Simulation.

C. BASIS FOR FY 1979 RDTE REQUEST: Complete development of the major programs initiated during FY77/FY78. Initiate research effort in medium to high risk technology areas, such as applications of liquid crystals, computer generated imagery, large scale integrated circuit design, fiber optics, adaptive optics, lasers, and microprocessors.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The Army's Non-Systems Training Device development programs have traditionally been financed exclusively with Category 6.4 funds (Engineering Development). Such a system was sufficient to support a training philosophy which embraced the use of simulation in institutions and the use of operational equipment as the unit's training support mechanism by using state-of-the-art technology. Escalating resource costs and diminishing training budgets compel the Army to introduce simulation and simulative devices into the unit environment. The Exploratory Development program determines how to develop devices which are cost and operationally effective in support of the unit environment, and improves the "front-end" analytical effort which will allow progression into Advanced Development. New technologies and applications for training devices will be explored.

Program Element: #6.27.27.A Title: Non-Systems Training Devices Technology
DoD Mission Area: #132 - Training and Personnel Technology Budget Activity: #1 - Technology Base

F. RELATED ACTIVITIES: The program is closely coordinated with the Navy and Air Force (currently conducting cooperative research in visual simulation), Joint Service Technical Coordinating Group, Training and Personnel Technology Conferences, Topical Reviews, joint use of resources at the Naval Training Equipment Center, and worldwide staffing of training equipment requirements. Related program elements are P.E. 6.37.38.A, Non Systems Training Devices Development; 6.47.15.A, Non-Systems Training Devices Engineering; 6.27.22.A, Army Training Technology; 6.22.05.F, Training and Simulation Technology; 6.27.57.N, Training and Human Engineering Technology.

G. WORK PERFORMED BY: Primary contractors: American Airlines, Fort Worth, Texas; General Electric Company, Daytona Beach, Florida; Decilog, Melville, New York; Unified Industries, Alexandria, Virginia. Additional potential or anticipated bidders include: Battelle Laboratories, Columbus, Ohio; Computer Science Corporation, Huntsville, Alabama; AAI Corporation, Baltimore, Maryland; International Laser Systems Incorporated, Orlando, Florida; Farrand Company, Valhallo, New York; Arthur D. Little Company, Cambridge, Massachusetts; and ITT Corporation, Nutley, New York. The above list does not represent a complete list of contractors that may bid competitively for approximately $1.8M. In-house development is performed by the U.S. Naval Training Equipment Center, Orlando, Florida, and by U.S. Army Development and Readiness Command Subordinate agencies as tasked by the Project Manager for Training Devices (PM TRADE).

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Completed research on eye safety of low power Gallium Arsenide (GaAs) Lasers. Results will be incorporated in the Surgeon General's revised criteria for use of lasers in the training environment. Results also assisted in the final design of the lasers used in the Multiple Integrated Laser Engagement System (MILES). Completed initial research and feasibility studies to determine feasible alternatives for Thermal Targets. Feasible technologies will be evaluated in a breadboard configuration during FY 1978. Initiated contract definition effort to determine the most feasible and cost effective alternatives for the Armor Full Crew Interaction Simulator (AFCIS) facility. Continued major research effort (cooperative effort with the Navy and Air Force) in the areas of wide-angle laser-scanning and 360° Annular Visual Systems, which are required for the wide field of view capability needed for future flight simulators and tank simulators. Initiated research in the area of Integrated Laser Optics, Electronic Warfare (EW) Simulation and Maintenance Simulation Technologies.

2. FY 1978 Program: Program provides for completion and/or continuation of research initiated during FY 77. Breadboard models of Thermal Targets will be completed and evaluated and results will feed directly into the ongoing Armor Remoted Target System advanced development program. Contract definition study for the AFCIS facility will be completed - selecting the most feasible/cost effective alternative to proceed into advanced development. Joint development effort on the visual systems will also be completed and results fed to the appropriate flight simulator programs as well as tank trainers for the M60 and XM-1 tanks. A major research effort will be continued for Integrated Laser Optics, EW Simulation Indirect Area Fire Simulation and Maintenance Simulation Technology.

Program Element: #6.27.27.A Title: Non-Systems Training Devices Technology
DoD Mission Area: #132 - Training and Personnel Technology Budget Activity: #1 - Technology Base

3. FY 1979 Planned Program: Complete and/or continue research initiated during FY 1977 and FY 1978. Overall program effort is geared towards research in medium to high risk technology areas, such as applications of liquid crystals, computer generated imagery, large scale integrated circuit design, fiber optics, adaptive optics, low powered lasers, and microprocessors. Research scheduled for completion during FY 1979 will provide feasibility studies and technology for indirect area fire simulators, tank gunnery simulators and maintenance trainers to proceed into advanced/engineering development. Modest increase reflects the Army's serious approach for developing a sound and responsive technology base program. Major effort is directed at more economical devices, wider use in unit training and in areas of higher training cost.

4. FY 1980 Planned Program: Complete research efforts initiated during FY 1978 and FY 1979, concentrating on technology areas which will provide the greatest return on investment by significantly reducing development, production and life cycle costs for all training devices and simulators.

5. Program to Completion: This is a continuing program.

FY 1979 RTD&E CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.30.A
DoD Mission Area: #153-Military Engineering Technology Base

Title: Cold Regions Engineering Technology
Budget Activity: #1-Technology Base

A. RESOURCE (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL PROGRAM ELEMENT	2591	2910	3072	3670	Continuing	Not Applicable
AT42-01	Ice and Snow Technology	287	320	350	450	Continuing	Not Applicable
AT42-02	Soils and Foundations Technology	522	500	550	650	Continuing	Not Applicable
AT42-03	Facilities Technology	672	978	1072	1270	Continuing	Not Applicable
AT42-04	Environmental Constraints on Materiel Development	1110	1112	1100	1300	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objectives of this project are: (1) to insure that the Army combat engineering capability is maintained in both a winter temperate zone or in an extreme cold environment; (2) to develop cost effective and environmentally compatible techniques and engineering criteria for the construction, maintenance and operation of permanent Army facilities in areas where cold weather presents a problem; and (3) to develop methods for identifying and evaluating how terrain, climate, and other environmental aspects constrain design and performance of Army materiel.

C. BASIS FOR FY 1979 RDT&E REQUEST: The FY 1979 request is based on requirements which support Corps of Engineers and Department of Army Development, Acquisition and Readiness Command (DARCOM). The first is to provide a marked reduction in the costs to operate and maintain military facilities in cold regions (northern US, Alaska, Europe, Korea). Operation and maintenance costs at these facilities currently average $64 million in excess of comparable costs for temperate zone facilities; much of this "add-on" cost can be avoided by solutions derived from research. The second requirement is to provide a combat engineering capability which will insure that US forces are at least on an equal basis with the expert winter combat capability of Eastern European countries. The third requirement supports DARCOM and is concerned with the design of weapons and equipment employed in winter warfare and other adverse conditions. The highest priority items in this area require solution to the problem of icing on the rotor blades of combat helicopters, weapon emplacement in snow and frozen ground, the impact of fuzes against snow covered targets, operation of vehicles in shallow snow and thawing soil, and ice fog generation by vehicles.

Program Element: #6.27.38.A
DoD Mission Area: #153-Military Engineering Technology Base

Title: Cold Regions Engineering Technology
Budget Activity: #1-Technology Base

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND DESCRIPTION: The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) provides centralized management for this project. Along with CRREL, research is conducted by the U.S. Army Engineer Waterways Experiment Station (WES) and the U.S. Army Engineer Topographic Laboratories (ETL). Research is being conducted in four areas: Ice and Snow Technology, Soils and Foundations Technology, Facilities Technology, and Environmental Constraints on Materiel Development. These tasks provide a coordinated research approach to solve the problems that cold weather causes on Army facility and materiel operations.

F. RELATED ACTIVITIES: Related programs are the Civil Works Research and Investigation programs on ice engineering and wastewater management; Project AT41 - Military Facilities Technology; and Project A896 - Environmental Quality for Military Facilities.

G. WORK PERFORMED BY: Approximately 60 percent of the work is performed in-house by the US Army Cold Regions Research and Engineering Laboratory, Hanover, NH. CRREL serves as the managing laboratory for this project, and is the primary performing activity. The remaining portions of the work are performed at the US Engineer Topographic Laboratories at Fort Belvoir, VA, the US Army Engineer Waterways Experiment Station, Vicksburg, MS, the US Army Facility Engineer Support Agency, Ft. Belvoir, VA, and US Army Engineer Division, Alaska.

H. PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Engineering reports were published on ballistic attenuation of ordinary snow, snow drift control problems, frequency and duration of various forms of freezing precipitation in relation to weather conditions, cutting and excavating frozen ground, ice bridging technology, winter time construction and ice reinforcement. Laboratory tests and field trials were conducted on foundations, quick curing of low temperature concrete, utility distribution systems and pavements. Research was translated into construction criteria with the issuance of Technical Manual (TM) 5-852-4 "Arctic and Subarctic Construction, Foundations for Structures", preparation of TM 5-852-7 "Subsurface Drainage Design for Airfields and heliports in Arctic and Subarctic Regions", TM 5-818-1, Chapter 18 "Design of Foundations in Areas of Significant Frost Penetration", Engineer Manual (EM) 1110-1b-501, "Process Design Manual for Land Treatment of Municipal Wastewater" and input to Field Manual (FM) 5-100, "Engineer Combat Operations". A laboratory ballistic testing program in which fragments simulating projectiles were fired into frozen soil furnished data on the influence of target temperature and moisture content on projectile penetration. A series of preliminary maps were prepared which show the probable dates of the earliest and latest occurrence of snow, and length of the snow season in East and West Germany. Equations were derived for concentrated rectangular shaped loads on ice sheets. Performance reports were completed on the Fort Yukon Aircraft and Control Warning Station and the Kotzebue Native Hospital, Alaska. Soil and permafrost investigations were conducted along the Trans-Alaska pipeline road to

obtain data on initial conditions of foundations, slopes, roads and airfields. Initial observations were taken along the pipeline route for long term performance surveys of thaw-consolidation and settlement of frost heaving piling. Other investigations include disposal, construction equipment and operation, and terminals and pump stations. Resistivity surveys were made in Alaska demonstrating application in locating permafrost, soil type and bedrock, with particular emphasis on grounding and cathodic protection potential.

2. FY 1978 Program: A final report is being prepared on winter fortification work, outlining the types and amounts of cold regions materials to defeat various small arms projectiles. Various types of equipment are being studied which will enable the combat engineer to build ice for use in roads and river crossings. Final reports are being completed on piles, footings and foundations in Alaska. A draft manual on habitability guidelines for cold regions facilities will be completed. Criteria are being developed for evaluation of pavements for frost conditions and design of roads, streets and parking aprons. A major effort is underway in locating water supplies in cold regions both from the standpoint of the military engineer and the facilities engineer. Work continues on ice adhesion and helicopeter de-icing, winter fortifications, weapons emplacement and vehicle mobility under adverse winter conditions. Work support continues for developers and materiel testers as well as recommending changes for design criteria for materiel. Techniques are being developed to evaluate the area over which ground based weapons will have the opportunity to attack helicopters.

3. FY 1979 Planned Program: Efforts will begin on developing non-metallic piping for utilities in cold regions. Final reports will be written on the experience with the permanent and temporary camps for the Trans-Alaska pipeline. These will discuss the construction and operations problems faced by Alaska in its construction camps. The work on moisture detection in roofs using non-destructive methods will be completed. A report will be completed on expedient protective structures, and a final report on "Design Criteria for Foundations in Cold Regions" will be published. The work on environmental effects on materiel will be reoriented to perform Decisive Risk Analysis stipulated by Army Regulations.

In-house personnel engaged in the program are 46 professional and 15 support.

4. FY 1980 Planned Program: Work will be completed in the combat engineering categories of expedient snow and rapid ice building for mobility. New work will begin in snow control, pipelines in permafrost, and a number of topics on water supply in cold regions. In the mobility area, efforts will be undertaken in oversnow vehicle technology and interaction between thawed soil and vehicle traction.

5. Program to Completion: This is a continuing program. Direct input will be made to facilities engineers concerning application of research results, and Army training and field manuals will be updated to reflect the expanded technology base.

FY 1979 RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: 6.27.31.A
DoD Mission Area: 4153-Military Engineering Technology Base

Title: Military Facilities Engineering Technology
Budget Activity: 1-Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to completion	Total Estimated Costs
	TOTAL PROGRAM ELEMENT	3955	2000	3500	4000	Continuing	Not Applicable
AT41-T1	Design and Construction of Fixed Military Facilities	2050	885	2625	3000	Continuing	Not Applicable
AT41-T2	Operations and Maintenance of Fixed Military Facilities	500	335	630	700	Continuing	Not Applicable
AT41-T3	Base Development in the Theater of Operations	200	80	245	300	Continuing	Not Applicable
AT41-T6	Military Energy Technology	1205	700				

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The program addresses the growing cost escalation in the construction, maintenance and operations of permanent Army installations, the shrinking manpower resources that are available to perform these functions, a growing backlog of maintenance and repair, and manpower intensive construction techniques used in base construction in the Theater of Operations performed by military personnel. The annual Army budgets for military construction and maintenance operations and repair of installations worldwide exceed 1.5 billion dollars and 1.8 billion dollars respectively. Major objectives of this program are: (1) to develop systems and techniques to improve productivity in planning, design and construction of military facilities, (2) to improve procedures for operation, maintenance and repairs of military facilities, (3) to develop construction methods and material applications for Field Army construction to emphasize rapid construction by engineer troop units that require fewer skills and less logistical support.

C. BASIS FOR FY 1979 RDT&E REQUEST: The FY 1979 research program includes: (1) development of computer-aided systems to review projected costs, justifications, and designs for conformance with criteria for proposed new construction and to evaluate utility system capacities for accomodating new construction, (2) development of a model earthquake survivability plan for Army installations to provide guidance on procedures for preparedness and recovery, (3) development of a computer program to identify required skill levels, manpower and equipment resources to accomplish the

various tasks assigned to engineer units for Field Army construction.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The objectives of this program are: (1) to maximize the productivity of Army manpower in planning, design construction, operation and maintenance of permanent installations supporting training and readiness; (2) to maximize the functional effectiveness of facilities to meet Army mission requirements and to minimize life cycle costs; and (3) to maximize the effectiveness of engineer troop units in performing Field Army construction missions. Specific objectives include: (1) developing automated systems to prepare cost estimates at the planning, budgeting and design stages of construction, to generate up-to-date military procurement and construction specifications, to review construct design solutions for conformance with regulatory criteria and to review adequacy of utilities and to assure functional effectiveness of the completed designs; (2) automated and manual systems for effective resource allocation of manpower to operate, maintain and repair existing military facilities; (3) alternatives to construction materiels, methods, quality control and repairs and maintenance techniques used in facility construction and operation, and (4) reducing shipping space and construction skills and effort for rapid construction by the troop units in the Theaters of Operations.

F. RELATED ACTIVITIES: Work funded in this program for facilities energy research has been transferred to PE 6.27.81.AT45, Military Energy Technology, in FY 1979. This program is coordinated service-wide through the Joint Service Civil Engineering R&D Coordinating Group, the Tri-Service Committee on Protective Coatings and the Integrated Facilities System Project Advisory Group. Coordination with intergovernmental agencies has been accomplished through joint activities on the Joint Services Buildings Materials Program with the National Bureau of Standards, Modular Integrated Utility Systems with Department of Housing and Urban Development (HUD) and participation in the National Academy of Sciences Building Research Advisory Board. Related programs include: Project AT23 - Basic Research in Military Construction: Construction on Engineering Research Laboratory, Champaign, IL. Project AT45 - Military Energy Technology; Construction Engineering Research Laboratory, Champaign, IL; Facilities Engineering Support Agency, Fort Belvoir, VA.

G. WORK PERFORMED BY: Approximately 60% of project funds are used for in-house effort at the Construction Engineering Research Laboratory.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAM:

1. FY 1977 and Prior Accomplishments: Accomplishments to improve the military facilities design and construction process include: (1) a computer aided system for the preparation of construction specifications, (2) an automated cost estimating system to reduce the time and increase the accuracy in the preparation of final design cost estimates, (3)

field tests of an automated system to review architectural design to assure conformance with Army regulations and other criteria, (4) concept design of a large scale integrated computer aided engineering and architectural design system, (5) field test of the automated program to check early budget estimates and justifications for proposed military construction, (6) a computer program to identify the best combination of industrialized building systems which meet Department of Defense criteria, (7) seismic design criteria for incorporation into the tri-service design manual, (8) criteria to insure that essential utility and lifeline systems design for hospitals and communication centers will remain functional following an earthquake, (9) development and miniaturization of chemical analysis test equipment for determining the strength of concrete while it is in the plastic state and (10) the development of a prototype weld quality monitor which measures the quality as the weld is being made. Accomplishments which increase productivity and improve resource allocation in operation and maintenance of military facilities include: (1) development of program to interface the Pavement Maintenance Management System with the Army Integrated Facility System, (2) development of requirements for incorporating new construction information into the Integrated Facility System to use in projecting workloads and budget impacts, (3) development of criteria to upgrade, repair and maintain maintenance shops to improve the safety, productivity, and work patterns of shop personnel and (4) development of a simplified computer program to schedule construction of temporary facilities in the Theater of Operations. An energy survey of all Army installations was completed and potential areas of significant energy savings was identified. Instrumentation was installed on three Army posts and data collected. In cooperation with the Navy, a survey of Reform Derived Fuel technology was completed. Methodology for conducting base-wide energy analysis was completed. An energy, index method to assist in managing energy consumption was complet[illegible].

2. FY 1978 Program: Scheduled accomplishments for improving the military construction process include field tests of a computer aided cost estimating system for generating final design cost estimates for projects scheduled for construction and field testing of an architectural design criteria on materials and workmanship to improve the quality of roof construction. Scheduled accomplishments to increase productivity in operation and maintenance of military facilities include field testing the condition rating system for built-up roofing, a shop layout guide for 12 operation and maintenance shop types for improving productivity. Development of an equipment maintenance system is being initiated to manage and schedule maintenance and repair of utility system equipment. Scheduled accomplishments for rapid construction in the Theater of Operations include a system to use polyurethane foam applied over an inflation forms to provide support for overhead cover in combat areas and completion of the development of work performance rates for use in scheduling men and materials for construction of Theater of Operations facilities. The research in FY 1978 involves 17 professional and 6 support personnel for the in-house effort and monitoring contracts scheduled for award during the year. Sheduled accomplishments include completion of a demonstration program of current-technology energy control systems for military bases; completion of a joint Army-Department of Energy (DOE) study on the application of solar-ponds as an energy collecting system for military-sized installations; field validation of an Army developed solar energy design analysis method for evaluating economic potential for use in heating and cooling of buildings; a joint Army-Air Force alternatives in retrofit and new construction. A direct cut in AT41 in FY 1978 has severely curtailed

efforts to evaluate new energy technology and stretched out other important work. For example, initiation of following projects was postponed - investigation of coal technology for use on military sized installations; use of microprocessors in energy control systems; and evaluation of current heating, ventilation and air conditioning (HVAC) technology. Programs delayed were: publication of a report on anlysis of Army facilities consumption; publication of a Tri-Service manual on current-technology energy control systems and test of the automated energy reporting system (ECRAS).

3. FY 1979 Planned Program: Research to improve the military construction process will include design of an integrated Computer Aided Engineering and Architectural Design System, development of a cost estimating system for use in preliminary design of facilities. completion of the computer aided system to evaluate existing and new utility systems, computerized selection of projects for the use of industrialized building systems, the development of a model earthquake survivability plan for military facilities, and guide specifications for the use of galvanized reinforcing steel in military construction to reduce corrosion. Research to improve the productivity in the operation and management of military facilities includes field testing of the condition rating procedures for roofing systems, development of a resource management system for facility maintenance and development of an information system to manage maintenance and operation of military family housing. Research for Theater of Operations construction includes laboratory tests for validation of materials, equipment and construction techniques for vertical construction in arid and tropical regions, and development of a system to assist in the identification of engineer troop capabilities. The increased research effort in FY 1979 will involve 27 professional and 11 support personnel. The funding increase of $1,500K in FY 1979 over FY 1978 is to: increase productivity of construction planning management and administration with a projected return on investment in excess of $2 million dollars per year ($640K); technology to utilize industrialized building systems in construction ($300K); improved productivity of the military construction process ($300K); earthquake protection for criterial Army facilities ($295K); improved facility engineering management and repair technology ($500K); and base development in the Theater of Operations ($165K);and eliminate funding for facilities energy transferred to PE 6.27.81.AT45, Military Energy Technology, in FY 1978.

4. FY 1980 Planned Program: Scheduled accomplishments to improve the military construction process will include the Computer Aided Architectural and Design System with a date for system completion in FY 1982, standard designs for earthquake resistant structural frames in Army facility construction, computer aided cost estimating system for preliminary design cost estimates during preliminary design. The $500,000 increase in project funds for FY 1980 is required for development of the Computer Aided Architectural and Engineering Design System. Scheduled accomplishments to improve the productivity in operation and management of military facilities will include completing the development of major subsystems in the integrated management model that provides force development planners with a rational method for determining the equipment mix for engineer field units, guidelines for the allocation of resources for maintenance and repair activities in the Theater of Operations and site selection criteria to plan construction of specific facilities in the Theater of Operations. The research effort in FY 1980 will involve 30 professional and 12 support

personnel.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.32.A

Title: Remotely Piloted Vehicles (RPV) Supporting Technology

DoD Mission Area: #124 - Target Exploitation

Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1455	1500	2375	3000	Continuing	Not Applicable
AF34	Remotely Piloted Vehicle (RPV) Supporting Technology	1455	1500	2375	3000	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this element is to develop technological capabilities in those areas which currently limit the operational potential of small RPVs for Army missions of reconnaissance, target acquisition, target designation, and artillery adjustment. Emphasis is being given to the key technological areas of aeronautics, jam resistant command and control, sensors, and future Army missions for RPVs. Examples of these activities include improvement of small engines and propellers, recovery guidance techniques for night and adverse weather, survivability and vulnerability, day/night/all weather sensors and jam resistant multi-control techniques. RDTE efforts are being directed toward establishing and expanding the capabilities of small RPVs, to improve overall system reliability, and to reduce life cycle costs wherever possible.

C. BASIS FOR FY 1979 REQUEST: As the RPV program enters engineering development for a daylight target acquisition, artillery adjustment, laser designation and reconnaissance system, subsystems need to be investigated for future mission requirements. Night and all weather sensors, longer range for laser designators, multi-control data links and ground control stations, approach guidance techniques and improved survivability will be investigated. A study of recovery techniques to be integrated into optimized automatic recovery systems for night and adverse weather operations will be completed. The Night Vision Laboratory, Electronics Command, is developing infrared sensors that offer potential for lower cost, reduced size, and reduced cooling requirements compared to conventional night vision devices. A program for the adaptation of these infrared imagers to an RPV configuration, which commenced in FY 78 will be continued. Miniaturization of components leading to a 35 pound prototype millimeter radar for use as an adverse weather sensor will continue.

D. OTHER APPROPPIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The objective of this element is to develop and evaluate technological capabilities relating to the RPV system and to adapt technology already in progress to RPV applications. Efforts will concentrate on those areas which currently limit the operational potential of RPVs for various Army missions. The areas include survivability,

propulsion, recovery, manufacturing technology, human engineering, aircraft configuration, radar, electro-optics, and command and control. The cost drivers in the Remotely Piloted Vehicle (RPV) system are the sensor packages and the data links. Except for daylight television, available sensors are too large or costly for RPV application. Investigations into RPV compatible pyroelectric vidicons and near infrared imagers will be pursued to reduce cooling requirements, size, and cost. Key components for the use of millimeter wave radar on RPVs will be developed, as a potential solution to adverse weather RPV operations. The multicontrol of RPVs is a second generation requirement which needs to be thoroughly investigated to develop a cost effective solution.

F. RELATED ACTIVITIES: In prior years the Department of Defense Advanced Research Projects Agency (DARPA) conducted RPV exploratory developments which gave initial impetus to the technologies specific to RPVs. In keeping with its mission, DARPA has phased out its efforts and the services must now conduct the supporting technology. The results of this element will be integrated into Advanced Development under Program Element (PE) 6.37.25.A., Remotely Piloted Vehicles (RPVs)/Drones. The US Air Force has exploratory technological efforts supporting the RPV mission area included in the following program elements: 6.27.02.F., Ground Electronics; 6.22.01.F., Aerospace Flight Dynamics; 6.22.03.F., Aerospace Propulsion; and 6.22.04.F, Aerospace Avionics. All RPV related efforts within the Services are being monitored in order to utilize applicable technology and preclude duplicative efforts. The formal mechanism to ensure coordination is the Joint Technical Coordinating Group on RPVs, which meets quarterly. Examples of this coordination include the Army being designated as lead service in conducting a joint service propulsion program for RPVs and Army cooperation with a Navy recovery program using steerable fabric wings.

G. WORK PERFORMED BY: The Research and Technology Lab - Headquarters, Moffett Field, CA and Applied Technology Lab, Ft. Eustis, VA; US Army Electronics Research and Development Command, Ft. Monmouth, NJ; Night Vision Lab, Ft. Belvoir, VA; and the US Army Human Engineering Laboratory, Aberdeen Proving Ground, MD. Contractors expected to participate are: Harris Corporation, Melborne, FL; General Electric, Uttica, NY; Texas Instruments, Dallas, TX; Perkin-Elmer, Norwalk, VA; Hughes Aircraft, Culver City, CA; Honeywell, Minneapolis, MN; Ford Aerospace, Newport Beach, CA; and Norden, Norwalk, CT.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: This was a new element beginning in FY 77. The areas investigated encompassed the following. Propulsion: Development of a multicylinder engine with nominal 20 horsepower and growth potential to 25 horsepower from existing two cycle components. Survivability: An investigation was conducted to determine the best methods for reducing the visual signature of RPVs. Fabrication and Structures: An in-house evaluation of several manufacturing techniques/ structural concepts was conducted. Command and Control: Work was started to convert an anti-jam data link from test frequencies to deployable frequencies.

Program Element: #6.27.32.A

Title: Remotely Piloted Vehicles (RPV) Supporting Technology

Budget Activity: #1 - Technology Base

DoD Mission Area: #124 - Target Exploitation

2. FY 1978 Planned Program: The FY 1978 program is continuing the efforts initiated during 1977. Propulsion: Engines have been transfered to advanced development for testing starting in February 1978. Recovery: Recovery techniques will be considered for automatic approach systems requiring night and adverse weather operations. Three to Five Micron Thermal Imagers: Work is starting on a thermo-electrically cooled thermal imager featuring low cost and low complexity. Command and Control: Work on an anti-jam data link is continuing. Radar: Subsystem and antenna analysis of a 35 pound prototype millimeter radar will be initiated.

3. FY 1979 Planned Program: Those efforts on-going in FY 1978 will be continued. The funding increase is due to the high priority given to future RPV mission requirements. Increased effort will be expended on potentially low cost imagers and lasers. Work on an anti-jam data link with multiple control capability will continue. Development of data processing and classification algorithims essential to a lightweight millimeter wave radar will begin. A program to demonstrate a thermo-electrically cooled sensor will continue, with flight testing to be done in FY 1980. Avionics subsystems and interface requirements for expendable payloads in existing expendable drones will be investigated. Fabrication will start on a low cost lightweight autopilot suitable for expendable drones. An investigation to reduce noise, radar cross section and improve the efficiency of the propeller and engine combination will start. Technique to reduce the radar cross section of mini-RPV airframe will be tested. The automatic recovery guidance study will be completed. If warranted, preparation for future fabrication will begin.

4. FY 1980 Planned Program: Those efforts on-going in FY 1979 will be continued. Increased effort will be expended on multiple control capabilities, longer range data links and improved sensors.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.33.A Title: Mobility Equipment Technology
DoD Mission Area: #154 - Mobility and Logistics Technology Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	9129	9870	9714	10680	Continuing	Not Applicable
AH20-01	Fuels and Lubricants	2054	2290	2253	2478	Continuing	Not Applicable
AH20-02	Countermine and Barrier Techniques	3898	4234	4167	4582	Continuing	Not Applicable
AH20-03	Combat Support Technology	3177	3346	3294	3620	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The work under this program is exploratory development in the areas of fuels, lubricants, power transmission fluids and corrosion preventive coatings, mine detection and neutralization, advanced tactical barriers and related concepts, camouflage, power generation, bridging, water and wastewater management, environmental control, marine equipment, containerization, construction equipment, expedient surfacing and soil stabilization. Army mission need is reflected in the unavailability of: field fortifications and obstacles that effectively provide the ability to economize forces, exhaust an attacking enemy and provide adequate gain in time to prepare for offensive action; anti-vehicular barriers that require reduced logistical and support burdens; controllable barrier systems that efficiently impede enemy units but permit safe passage of friendly forces; highly competent means of stand-off detection of surface laid mines; a family of mine neutralizers for use by air and ground vehicles and in a man-pack mode; sufficiently strong, advanced, light weight mobile bridging structures for Class 60 bridges; highly efficient smoke, obscurants and camouflage techniques for thermal decoy that provide low emissivity in the dark; expedient means for soil stabilization and surfacing, and means for provision of rapid logistics over the shore operations; high efficiency fuel cell catalysts and electrodes for silent power generation; economical and effective air conditioning capabilities for combat vehicles and shelters; means for providing low vulnerability fuels to help generate significant improvement in combat vehicle survivability; detailed understanding of effects of alternate fuels on combat vehicle operation and performance; adequate guidelines for reliable use of extended-interval oils and lubricants and re-refined oils; and highly reliable hydraulic fluids with improved fire resistance, low-temperature operational properties and potential for economical use.

C. BASIS FOR FY 1979 RDTE REQUEST: Requested funds provide for investigation for chemical biological and radiological protection for armored combat vehicles; continue work on low cost fuel cells, improved power distribution, and new air conditioning concepts. Increase programs to improve close-in buried minefield detection and stand-off surface minefield detection, close-in neutralization of minefields via demagnetizing armored vehicles, stand-off neutralization of minefields by means of high energy explosives and remotely controlled vehicles, advanced barrier systems including engine interferring agents and foam generation capabilities. Investigate military effectiveness and perform systems analysis of field fortifications.

Program Element: #6.27.33.A Title: Mobility Equipment Technology
DoD Mission Area: #154 - Mobility and Logistics Technology Budget Activity: #1 - Technology Base

Develop improved methods for supply distribution, excavation, camouflage, explosive and minefield detection and neutralization. Develop and evaluate membranes and microstrainers for water supply with ability to remove trace turbidity. Evaluate water detection methods for desert environments. Evaluate coatings and adhesives for Kevlar seamless water supply tanks. Develop criteria for closed circuit automatic refueling of combat vehicles. Continue major programs to develop and evaluate improved multi-purpose anti-freeze, high performance engine oils, high-energy fuels, and non-flammable hydraulic fluid. Significantly accelerate and expand programs to develop means to modify ground combat vehicle fuels to satisfy urgent need for improved fire survivability. This program will experience a small decrease in FY 1979 over FY 1978.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This program covers those efforts directed towards overcoming all conceivable obstacles to mobility, whether the obstacles are enemy created, naturally created, or are a result of our own logistic shortcomings. Concurrently, this program explores systems for the physical security of our forces and support activities by the use of new and advanced camouflage techniques, new barriers and intruder detection devices. It covers exploratory development efforts to detect and neutralize minefields; it covers new and improved marine and bridging capabilities to by-pass minefields and/or to cross water and land gap obstacles. New and improved mobile electric power sources and distribution means are explored. It covers efforts to determine whether or not Army diesel engines can operate satisfactorily on non-specification fuels, e.g., those with a high sulfur content which are common in many parts of the world. At the same time, new formulations are tested to significantly decrease the fire hazard of fuels, lubricants and hydraulic fluids used in our combat and tactical vehicles. Finally, it covers water purification systems, containerized, bulk cargo and fuel handling equipment, logistics watercraft, environmental control, and rapid construction materials and means, to provide the support needed to sustain Army mobility and logistics in an hostile environment.

F. RELATED ACTIVITIES: In the fuels and lubricants technical area, active liaison and coordination is maintained with other Services, the Environmental Protection Agency, Federal Aviation Administration and Department of Energy. The Countermine and Barrier Technical Area provided direct support for advanced and engineering development program elements 6.36.06.A, Landmine Warfare; 6.36.19.A, Countermine and Barriers; 6.46.19.A, Landmine Warfare; and 6.46.12.A, Countermine and Barriers. Combat Support Technology area interfaces with other Services and agencies through the Interagency Advanced Power Group, Logistics Systems Policy Committee, Joint Container Steering Group and Program Manager for Army Container-Oriented Distribution System.

G. WORK PERFORMED BY: In-house work by US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA; US Army Engineer Waterways Experiment Station, Vicksburg, MS; Yuma Proving Grounds, Yuma, AZ; US Army Armament Research and Development Command, Aberdeen, MD; and Harry Diamond Laboratories, Washington, D.C. Contractual support is provided to Southwest Research Institute, San Antonio, TX; SKF Industries, Philadelphia, PA; Yucca MI; International, Incorporated Scottsdale, AZ; Energy Research Corporation, Dansbury, CT; Chrysler Corporation, Detroit MI; Goodyear Aerospace, Akron, OH; and Beckman Industries, Carlsbad, CA. Additional contracts are planned amounting to $1.7 million.

Program Element: #6.27.33.A Title: Mobility Equipment Technology
DoD Mission Area: #154 - Mobility and Logistics Technology Budget Activity: #1 - Technology Base

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Completed vulnerability and engine tests of first generation fire-safe fuels; completed a survey on high energy fuels for Army vehicles; completed base line engine tests for discriminating fuel sulfur effects; developed multigrade gear oil for ground combat vehicles eliminating seasonal change; developed an all-purpose silicone brake fluid and completed specification on this fluid. Developed and tested new high flux dry reserve osmosis membrane, ultra-filtration, and new techniques for treating brackish, contaminated and salt water supplies. One year service test of a scale model sleeve oil storage tank at the Tropic Test Center successfully completed. Completed lifetime tests of inexpensive fuel cell electrodes with one-tenth of the conventional platinum loading. Demonstrated that new organic acid electrolyte produces 15 percent higher performance than conventional phosphoric acid in fuel cells. Demonstrated feasibility of new air-cycle air conditioning concept for combat vehicles and shelters. Fabricated and test operated a 36 thousand BTUH air conditioner powered by waste heat from diesel engine exhaust. Developed bridging model to provide stress data for mobile bridges. Completed determinations on color coatings, design of color image software, smoke, foam, radar decoys, synthetic snow material and thermal signature reduction for camouflage applications. Demonstrated feasibility of hardening combat vehicle components to mine blasts, quantified user needs for Soviet type mine roller, demonstrated feasibility of using airborne harmonic radar with synthetic aperture processing, initiated comprehensive survey on airborne sensor technology for minefield detection, and demonstrated feasibility of detecting airborne explosive vapors by enzymatic process for field user. A back pack harmonic radar mine detector with 30 percent weight reduction was completed that meets the initial field requirements. The following concepts feasibility was demonstrated: thermal (infrared) imaging devices, metal reradiation devices, high resolution short pulse radar, and microwave devices for mine detection. Bridging anti-personnel minefields with quick hardening foam was demonstrated. The use of nuclear magnetic resonance to detect explosives was investigated. Plasma chromotography was evaluated as an explosive trace gas detector. Magnetic signatures of US and foreign vehicles were studied for use in signature duplicators. Effectiveness of the Soviet mine roller was evaluated. The effectiveness of fuel air explosives against pressure fuzed mines was evaluated. Developed laboratory test and simulation devices to establish camouflage baseline data and measure effectiveness of new materials and methods. Established criteria, performed design analysis, and began composite materials studies to support trilateral US/UK/FRG program for bridging in the 1980's.

2. FY 1978 Program: Develop technical approaches for integration of environmental control with chemical/biological/radiological protection for armored vehicles. Formulate comprehensive plan for distribution of electric power. Complete performance optimization of low cost fuel cell cathodes. Establish operating conditions for improved organic electrolyte fuel cells. Develop silicon carbide fuel cell matrices for increased reaction rate and carbon monoxide tolerance. Continue analysis and tests on improved air cycle and absorption cycle air conditioning systems. Investigate distribution systems for ammunition resupply. Investigate rock mechanics and underground construction for military shelters. Evaluate foreign entrenching machines. Develop bridging concepts, materials and methods for the 1980's. Continue programs on smoke, foam, camouflage, and other methods for reduction of thermal and radar signatures. Complete Logistics-Over-The-Shore systems analysis and air cushion barge analysis. Evaluate an airborne metal reradiation prototype for long range detection of scatterable minefields. Examine a

variety of techniques for stand-off buried minefield detection. Continue evaluation of an off-route buried minefield detector, a man-portable metal rerradiation detector, and explosive detectors. Demonstrate the use of ground-vehicle mounted systems for mine neutralization. Continue efforts on engine interference and tractive entanglements, for engine oils, and issue specification for helicopter spline grease. Study chlorine resistant seawater membrane for water purification. Investigate improved methods for removal of chemical warfare agents from masks.

3. FY 1979 Planned Program: Continue effort on simplification, cooling, and modularization of power conditioners. Define distribution system components. Complete performance optimization of improved fuel cell anodes. Develop components for advanced acid electrolyte fuel cells. Assemble and check hybrid power source components. Initiate exploratory development of second generation absorption cycle air conditioner and combat vehicle environmental support system. Continue work on selected minefield sensors such as multispectral photography and electromagnetic techniques. Continue program on short pulse radar and man-portable metal rerradiation detectors. Accellerate work on sprayed fuel-air explosives and vehicle demagnetization. Continue programs on engine interferences and slippery substances for barriers. Investigate new and improved bridging materials and advance bridge types. Continue work on smoke, foam, multi-spectral coatings, and thermal and radar signatures, for camouflage. Prepare concept formulations for air cushion barge. Evaluate improved high-speed excavation equipment. The decrease in funding in FY 1979 is related to completion of Logistics-Over-The-Shore and air cushion barge systems analysis.

4. FY 1980 Planned Program: Explore feasibility of use of graphite intercalation compounds for electric cables. Develop components for advanced fuel cells. Continue efforts on stand-off buried minefield detection and man-portable metal rerradiation detection. Increase level of effort on vehicle component hardening and demagnetization. Continue efforts on slippery substances for barriers. Complete visibility/safety device evaluation, test of vibratory dozer blade mechanism, and test of high pressure exhaust gas explosive kit to aid excavation. Continue concepts/manuals development for bridging. Continue smoke, foam, and multi-spectral coating work. Test air cushion barge. Continue determinations of wastewater reuses and ground water detection and purification. Continue efforts towards fuel storage tank materials, rapid deployment, and closed circuit refueling. Continue performance evaluation of oil compounded from re-refined base stocks, and high sulfur fuels. Evaluate power transmission fluids; test fire-safe fuel filters/decontaminators and high energy fuel filter/decontaminators.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.34.A
Title: Medical Defense Against Chemical Agents
DoD Mission Area: #135 - Chemical Biological Warfare Technology Base
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5504	6448	6027	5639	Continuing	Not Applicable
H26	Medical Defense Against Chemical Agents	5504	6448	6027	5639	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Death, disability, and significant decrements in combat performance resulting from hostile use of chemical agents is a battlefield threat. Adequate medical protection from and treatment of warfare chemical exposures do not exist. There is no satisfactory antidote against atropine-resistant anticholinesterase agents. Antidotes for such agents comprise an important part of national defense against chemical warfare. This program will develop: drugs, equipment, and methods required to furnish prophylaxis, and therapy for poisoning by lethal, incapacitating, and riot control agents; skin decontamination and protective methods and materials; and improve accuracy of psychological tests, measure performance decrements in man after agent exposure; and new biological assays for warfare agents and drugs. No work is underway in development or testing of chemical warfare agents.

C. BASIS FOR FY 1979 REQUEST: Bis-4 pyridine aldoxime tetramethylene dibromide-atropine sulfate-benactyzine hydrochloride (TAB) antidote mixture can prevent death in experimental animals challenged with lethal doses of chemical agents, but does so at the cost of marked incapacitation. Extent of incapacitation will be defined and projections made on how this will influence use in terms of dose size and frequency. Replacement drugs are under development. A procedure and cleanser will be identified for rapid decontamination of patients. The most practical defense against chemical warfare agents is effective protection. Therefore, 24-hour protection without loss of physical freedom is required. Pyridostigmine will be evaluated as a prophylactic medication. Data in support of Food and Drug Administration approval are being gathered.

D. OTHER APPROPRIATION FUNDS: Not Applicable

E. DETAILED BACKGROUND AND DESCRIPTION: Research is directed toward development of drugs, equipment, and procedures useful in furnishing prophylaxis and therapy for poisoning by all chemical warfare agents including equipment and procedures for self-administered prophylaxis and therapy; optimal procedures for applying protective, therapeutic, and decontamination materials; and new skin decontaminants.

Program Element: #6.27.34.A
#135 - Chemical Biological Warfare
DoD Mission Area: Technology Base

Title: Medical Defense Against Chemical Agents

Budget Activity: #1 - Technology Base

F. RELATED ACTIVITIES: All work is coordinated with quadripartite nations, Air Force, and Navy. Investigation of performance decrements from Bis-4 pyridine aldoxine tetramethylene dibromide-atropine sulfate-benactyzine hydrochloride (TAB) antidote using flight simulators is a joint effort with scientists at Brooke Air Force Base, Texas.

G. WORK PERFORMED BY: Biomedical Laboratory, Chemical Systems Laboratory, Edgewood Area, Aberdeen Proving Ground, MD, are the principal in-house performers, in conjunction with Johns Hopkins University, Baltimore, MD; Stanford Research Institute, Palo Alto, CA; Ash Stevens, Detroit, MI; University of Kansas, Manhattan, KS; Walter Reed Army Institute of Research, Washington, DC and Army Natick Research and Development Command, Natick, MA.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Nerve agent antidote TAB was fielded with Investigational New Drug petition approved and shelf life extended. A new first generation prophylaxis for nerve agents was selected and Investigational New Drug submission started. Improved therapeutic regimens have been defined and work for Investigational New Drug submission started. Emphasis on total prophylaxis has resulted in drugs protecting against nerve agents. A pathogenic model for mustard induced lesions was defined and therapy started. Accomplishments prior to FY 77 include development, adaptation, and fielding of therapies for organophosphate poisoning; development and fielding of the therapeutic mixture of TMB-4, atropine, and benactyzine, called TAB; and identification, development, and adaptation of pyridostigmine as a high priority candidate prophylaxis medication.

2. FY 1978 Program: Areas of emphasis include: (1) field a first generation prophylaxis against nerve agents, pyridostigmine; (2) complete 50% of effort to support Investigational New Drug (IND) submission to the Food and Drug Administration for second therapy; (3) complete remaining IND requirements for Bis-4 pyridine aldoxine tetramethylene dibromide-atropine sulfate-benactyzine hydrochloride; (4) complete 50% of development of a field diagnostic test for agents in body fluids; (5) complete 50% of studies of performance decrements to visual systems; (6) complete 75% of modification of Halsted-Reitan Battery to allow neurologic assessment of individuals previously exposed to chemical agents; and (7) complete 25% of work to develop a safety surveillance method to determine exposure to mutagenic chemicals used in chemical defense research.

3. FY 1979 Planned Program: Areas of emphasis and planned accomplishments include: (1) completion of 90% of modification of Halsted-Reitan Battery for assessment of individuals previously exposed to chemical agents; (2) completion of 50% of methods of safety surveillance of exposure to mutagenic chemicals used in chemical defense research; (3) completion of required Food and Drug Administration supplements to pyridostigmine or TAB IND approvals; (4) completion of 60% of FDA IND submission for second generation therapy; (5) continuation of studies on enhancement of first and second generation prophylaxis and therapy; (6) continuation of search for a prophylactic mixture not dependent on therapy and free of significant decrement to performance; (7) completion of 90% of development of first generation field diagnostic tests; (8) completion and publication of survey of state-of-art for rapidly exploitable diagnostic methods for field and hospital use; (9) continuation of decrement of neurological function assays; (10) special emphasis on skin protection and decontamination; (11) continue search for ways to extrapolate animal data to man; (12) continuation of work on cyanide, glycolate, and phosgene prophylaxis and therapy; (13) continuation of mustard management and therapy studies; and (14) completion of survey for staffing potential combat medical problems due to mixes of other types of injuries with chemical injury.

4. FY 1980 Planned Program: Areas of emphasis and planned accomplishmnet for FY 80 include: (1) completion of Halsted-Reitan Battery to assess individuals previously exposed to chemical agents; (2) completion of 75% of methods of safety surveillance of exposure to mutagenic chemical used in chemical defense research; (3) completion of required FDA supplement to pyridostigmine or TAB IND's; (4) completion of 75% of FDA IND submission of second generation therapy; (5) completion of 50% of studies on enhancement of first and second generation prophylaxis and therapy; (6) continuation of search for prophylactic mixture not dependent on therapy and free significant decrement of performance; (7) completion of studies to decide which field diagnostic tests are feasible; (8) completion of 75% of exploitation of field assay technology; (9) completion of decrement of function assay of the visual system; (10) completion of screen of first generation prophylactic skin coatings; (11) acquisition of working models and correction factors for extrapolation between species and to man; (12) completion of first draft of mustard management; and (13) determination of areas of combat medical problems due to mixes of other injuries with chemical injury and initiate a program to deal with critical data deficiencies.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.27.70.A Title: Military Infectious Disease Technology

DoD Mission Area: # 131 - Medicine and Life Sciences Budget Activity: # 1 - Technology Base

A. RESOURCES (PROJECT LISTING) ($ in thousands):

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	14001	15030	15154	15250	Continuing	Not Applicable
A802	Military Preventive Medicine	6544	7348	7820	7726	Continuing	Not Applicable
A803	Drug Development	7457	7682	7334	7524	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Objectives of the program are to conduct studies of bacterial, viral, parasitic and rickettsial diseases of military importance. Research includes investigations in epidemiology, control, prevention, treatment and evaluation of their impact on military operations. Methods for laboratory investigations are explored, developed, and standardized. Separate descriptive summaries are included for projects A802 and A803.

C. BASIS FOR FY 1979 RDTE REQUEST: Research will be on specific infectious diseases that have the greatest impact on troops in combat operations and training exercises. Concentrated efforts will be on providing data on the diseases, their reservoirs, arthropod vectors, and development of new or improved drugs for treatment of vaccines for prevention of infection. Specific military important diseases to be studied are malaria, leishmaniasis, schistosomiasis, scrub typhus, adeno- and arbovirus infections, and trypanosomiasis. New field and laboratory techniques for disease vector control will be developed and evaluated.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This program includes studies required to develop preventive measures and improved diagnostic and treatment methods for infectious diseases of military importance, to include parasitic, viral, bacterial, and rickettsial diseases. Epidemiology data will be gathered providing information on the transmission, ecology, control, vectors, and reservoirs of malaria, adeno- and arboviruses, leishmaniasis, trypanosomiasis, and rickettsial diseases. A major portion is devoted to development of improved methods for preventing, curing, and eradicating malaria as a menace to military forces.

F. RELATED ACTIVITIES: Army studies related to this program element are performed under program elements/projects 6.11.02.A/BS01, Basic Research on Military Injury and Disease; 6.11.02.A/BS03, Medical Defense Against Biological Agents; 6.27.76.A/A841, Medical Defense Against Biological Agents; and, in FY 79, program element 6.37.50.A, Drug and Vaccine Development. Complementary research is performed by the National Institutes of Health, Department of Agriculture, and Navy. However, the unique aspects of Army field operations dictate an Army program that focuses on optimal support of military operations and learning to recognize, prevent and treat infectious diseases that cause more lost duty time than combat wounds. Army representation on Department of

Defense coordinating committees, intergovernmental agency coordinating councils and committees insures coordinating at the working and administrative levels in order to prevent unnecessary duplication of effort. Army scientists serve as consultants with the World Health Organization and have access to that organization's studies, reports, and publications. Other coordination is accomplished by site visits by project officers, organization of symposia on selected topics, routine exchange of reports among staff and laboratory organizations, open publication of results in scientific journals, and distribution of research and technology résumés.

G. WORK PERFORMED BY: About 43% of the research is performed by in-house laboratories at Walter Reed Army Institute of Research and field units in Thailand, Malaysia, Brazil, and Kenya. The remaining work is conducted by extramural contractors of whom the following are representative: Midwest Research Institute, Kansas City, MO; Bio-Med Inc., Silver Spring, MD; Monsanto Research Corporation, Dayton, OH; University of Miami, Miami, FL; and Southern Research Institute, Birmingham, AL. Seventy other contracts are supported by this program. Total contract funds equal $8,616,000.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Vaccines were developed, which resulted in dramatic decreases in the incidence of adenovirus infections and meningococcal meningitis in troops in recruit centers. Vectors of malaria and filariasis were identified in Southeast Asia and the vector of leishmaniasis was studies in Brazil. Malaria vector control by the use of sterile males was proven to be a feasible technique. Techniques for isolation and purification of malarial ookinetes from mosquitoes were developed. Properties of E. coli and Salmonella bacteria which cause diarrhea were identified. An improved radioimmunoassay technique for identification of hepatitis B was developed. Adenovirus type 21 was identified as a pathogen of potential importance. Animals were successfully immunized with an irradiated trypanosome vaccine and with vaccines prepared from irradiated forms of malaria parasites. A coordinated program for the development of antimalarial drugs was established and resulted in the screening of more than 225,000 drugs of which more than 25 were tested in man. Recent emphasis was placed on synthesis and testing of new 8-aminoquinolines, several of which had greater activity against malaria than drugs previously used. A catalog of world mosquitoes was published, which provides data necessary for advanced studies of mosquito-borne diseases. Culture techniques of falciparum parasites were markedly improved so that maintenance of the culture now lasts for several weeks. This information can be used in developing an in vitro testing system for antiparasitic drugs.

2. FY 1978 Program: Continued studies are conducted on the preparation and testing of promising drugs for prevention and treatment of resistant and susceptible strains of malaria. Actual infection rates of leishmaniasis in troops operating in endemic areas are being determined. Additional evaluations of antiparasitic agents effective against leishmaniasis and virus infections are made. Preventive methods against diarrhea in troops are developed and evaluated. Research continues on vaccine development for dengue type 3, adenovirus, and trypanosomiasis. Identification aids to malaria vectors for use by military disease control teams are being completed and published. Collection and analysis of data on infectious diseases of military importance continue with the goal of making improvements in diagnosis, prevention, control, and treatment.

3. FY 1979 Planned Program: Modification of the drug development program will be completed to provide an integrated approach

for antiparasitic drug synthesis, screening, and evaluation. This system will develop preventive and treatment drugs for the following military important diseases: Malaria, leishmaniasis, and schistosomiasis. It will provide more rapid development under project A803, leading to advanced human testing. Development of a new delivery system for antileishmanial drugs will continue. An identification manual will be published on the vectors of leishmaniasis for use by vector control personnel. New control techniques for arthropod vectors of disease will be evaluated in field studies. Vaccine development studies will continue for trypanosomiasis, malaria, and dysentery.

4. FY 1980 Planned Program: Research will be directed toward development of new or improved products for the prevention, control, and treatment of infectious diseases having the greatest impact on military combat operations. Studies designed to provide data on the host-parasite-vector relationships of diseases of military significance will be conducted. New antiparasitic drugs and vaccines will be developed to provide protection to troops operating in endemic disease areas.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A802
Program Element: #6.27.70.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Military Preventive Medicine and Tropical Diseases
Title: Military Infectious Disease Technology
Budget Activity: #1 - Technology Base

A. DETAILED BACKGROUND AND DESCRIPTION: Infectious diseases have been the main cause of manpower loss in all wars in and outside the combat zone. In Vietnam, two thirds of all casualties were due to infectious diseases; in 1968, two million man days were lost in non combat areas overseas due to infections. Every element of the military force is affected. The strategic mobility of US forces to support national interest is enhanced by an ability to cope with diseases peculiar to other parts of the world. Tropical areas are a source (and sometimes the only source to the Free World) of many key resources required by the US, but these areas also represent significant infectious disease hazards, e.g., the recent occurence of African hemorrhagic fever in the Sudan and Zaire. Research efforts must begin well before troops are deployed since years are required to develop acceptable preventative and therapeutic procedures for any disease. The research supports a broad and continuing military field and laboratory oriented program essential to the recognition, prevention, treatment, and control of infectious diseases of military significance and crucial to fostering the national interests. This is a balanced program between in-house (which also serves to retain and maintain a quick response Department of Defense (DOD) strike force of tropical disease experts) and extramural efforts that are complementary to the in-house program.

B. RELATED ACTIVITIES: Related efforts are performed under program element projects 6.11.02.A/BS01, Basic Research on Military Injury and Diseases, BS02, Basic Mechanism of Recovery from Injury; and 6.27.70.A/AB01, Drug Development. Small complementary programs exist in the Navy, Department of Agriculture and Public Health Service. Army representation on Department of Defense committees and other intergovernmental agencies (e.g., Armed Forces Epidemiological Board) to insure coordination at the working and administrative levels to prevent unnecessary duplication of effort. Army scientists serve as consultants with the World Health Organization and have access to this Organization's studies, reports, topics, routing exchange of reports among staff and laboratory organizations, open publication of results in scientific journals and distribution of research and technology resumes.

C. WORK PERFORMED BY: The Walter Reed Army Institute of Research performs most of the in-house work in this Project. Overseas efforts are conducted by field laboratories of the Walter Reed Army Institute of Research in Thailand, Brazil, Malaysia, and Kenya. Approximately 49% of the effort is supported by in-house research and 51% by extramural contracts. Five of the largest contracts are with the New York University, New York, NY; Smithsonian Institution, Washington, DC; University of Georgia, Athens, GA; University of California, Berkeley, CA and University of Massachusetts, Worchester, MA. Thirty six other contracts are supported by this program. Total contract funds equal $3,747,000.

Project: #A802
Program Element: #6.27.70.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Military Preventive Medicine and Tropical Diseases
Title: Military Infectious Disease Technology
Budget Activity: #1 - Technology Base

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Adenovirus vaccine against types 4 and 7 adenovirus diseases markedly reduced the incidence and morbidity of adenovirus infections in recruit center, leading to significant training cost savings. Vaccines against groups A and C meningococcal meningitis were developed, which provided protection from those diseases and resulted in a dramatic drop in the number of cases and deaths of recruits due to meningitis. Arthropod-borne diseases were studied in tropical and subtropical areas. From these studies data were established on the vectors of malaria arbovirus diseases and filariasis in Southeast Asia. Several epidemiologic studies were conducted on infectious diseases transmitted among populations along the Trans-Amazon Highway. Ecological studies of the sand fly vectors of leishmaniasis were conducted providing considerable new information on these an-hiting flies. Additional information was accumulated on the use of hyperbaric glucose-amphotericin in the treatment of coccidioidal meningitis. Simplified models of the dynamics of mosquito-vector populations were developed and related to control technology. The feasibility of malaria vector control by the sterile-male mosquito control technique was proven. Techniques were developed for the isolation and purification of malarial ookinetes from mosquitoes. Identified diarrhea causing properties of E. coli and Salmonella bacteria. A new radioimmunoassay for hepatitis B identification in serum has retained the necessary sensitivity and increased the specificity for detection of this virus. Adenovirus type 21 was identified as a possible emerging strain of adenovirus. Animals were successfully immunized with irradiated trypanosome vaccines. Strains of swine influenza in military personnel were characterized and antisera prepared. Several hundred compounds were evaluated for efficacy in repelling insect vectors; heat chemicals will be evaluated in field tests. Catalog of world mosquitoes published which provides data necessary for advanced studies of mosquito-borne diseases.

2. FY 1978 Program: Studies will be conducted to determine the actual infection rate of leishmaniasis among soldiers operating in an endemic disease area during jungle warfare training. A new liposome drug delivery system for use in treatment of leishmaniasis will be explored. Studies will be continued to determine the mosquito vectors of malaria in a jungle area where known vectors are absent. Identification key to malaria vectors for use by military disease control teams will be published. A promising vaccine against dengue type 3 will be more fully characterized and developed. Research on development of an effective treatment of scrub typhus will continue. Overwintering mechanism of insect-borne viruses will be elucidated as a prelude to control techniques of these troop incapacitating diseases. Alternative methods of isolation and serological tests of adenoviruses will be completed in order to assure effective vaccine development. A laboratory colony of tsetse flies will be established for use in evaluating potential vaccines against African trypanosomiasis. Immune responses of diarrhea causing bacteria will be evaluated to develop mechanism for prevention and control of this disease in soldiers.

Project: #A802
Program Element: #6.27.70.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Military Preventive Medicine
Title: Military Preventive Medicine and Tropical Diseases
Budget Activity: #1 - Technology Base

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAM:

3. FY 1979 Planned Program: The delivery system for antileishmanial drugs will continue to be developed and evaluated. An identification manual of the vectors of leishmaniasis will be published for use by vector control personnel. Evaluation of wild rodent, chigger and human scrub typhus strains will be studied so that necessary data can be obtained for use in early developmental studies of a vaccine. A mosquito-virus model will be further developed for determining the mechanisms involved in the overwintering of pathogenic arboviruses. A new control method for mosquito vectors will be evaluated in field tests. This method has potential in integrated pest management programs with a reduced decrement of the environment. Development of an animal model will be completed and utilized in evaluating an experimental vaccine against African trypanosomiasis. Primary evaluation studies will be conducted on a vaccine against dysentery.

4. FY 1980 Planned Program: Studies will continue to be directed to development and evalutaion of data and products which can effectively be used in control strategies of infectious diseases responsible for morbidity and mortality of troops in combat and training operations. Efforts will be toward providing protection of treatment of soldiers against military important viral, parasitic, bacterial and rickettsial diseases.

5. Program to Completion: This is a continuing program.

6. Major Milestones: Not Applicable

7. Resources ($ in thousands):

RDTE,A: Funds	FY 1977	FY 1978	FY 1979	FY 1980	Additional to Completion	Total Estimated Cost
	6544	7348	7820	7726	Continuing	Not Applicable

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A803 — Title: Drug Development
Program Element: #6.27.70.A — Title: Military Infectious Diseases Technology
DoD Mission Area: #131 - Medicine and Life Sciences — Budget Activity: #1 - Technology Base

A. DETAILED BACKGROUND AND DESCRIPTION: An immedicate requirement exists for more effective and less toxic drugs for prevention and treatment of diseases of military importance, such as malaria, leishmaniasis, schistosomiasis, trypanosomiasis and viral diseases. The disease-causing parasites and their vectors are constantly changing and developing resistance to current drugs and insecticides. These parasitic diseases are worldwide problems and have been pivotal in every major war; for example 90,000 casualties were due to malaria in Vietnam. Leishmaniasis was a significant disease problem of troops in the 1973 Yom Kippur war. Schistosomiasis reportedly stopped a communist Chinese invasion of Taiwan in 1950, and African trypanosomiasis is expected to be a critical problem to troop deployment in Africa. Even though new antimalarial drugs and insecticides have been developed, malaria has reappeared in a number of areas, e.g. India, Pakistan, parts of Africa and Central and South America from which it had been eliminated. Disruptions in a country resulting from combat-operations foster an increase of malaria and other infectious diseases. In order for the Army to operate effectively in areas in which these diseases are endemic, new and effective means of prevention and treatment are needed. Since these diseases do not occur in the United States, the military has a unique requirement for research and development efforts to solve the problem of these devastating diseases. To remedy the problem, a well balanced program of laboratory, clinical and field research is directed at developing new or improved methods for preventing and curing these diseases. A major effort is directed at development of drugs against resistant forms of malarial organisms.

B. RELATED ACTIVITIES: Related work is performed under Program elements projects 6.11.02.A/BS01, Basic Research on Military Injury and Diseases, 6.27.70.A/A802, Military Preventive Medicine and Tropical Diseases, and in FY 79 under 6.37.50.A/A808 Drug and Vaccine Development. Some complementary research is conducted by the Department of the Navy and National Institute of Allergy and Infectious Diseases. The Army Program is unique and is the only significant program of systematic search for drugs to prevent and cure the military important diseases. Coordination of the program is achieved by project officer visits to in-house and extramural contractor laboratories, and conferences and symposia with participants from all over the world.

C. WORK PERFORMED BY: About 37% of the work is performed in-house at the Walter Reed Army Institute of Research, Washington, DC, and its affiliated field units in Thailand and Brazil. Approximately 63% of the work is done under contract with universities, research institutes and industry. Among the five top contracts are those with the Midwest Research Institute, Kansas City, MO; Bio-Med Inc., Silver Spring, MD; University of Miami, Miami, FL; Monsanto Research Corporation, Dayton, OH; and Southern Research Institute, Birmingham, AL. Twenty-nine other contracts are also funded for drug development. Total funds supporting the extramural program equal $4,869,000.

Project: #A803
Program Element: #6.27.70.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Drug Development
Title: Military Infectious Diseases Technology
Budget Activity: #1 - Technology Base

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: A program for development of new antimalarial drugs was established and subsequently refined by inclusion of several new test systems. An automated information storage and retrieval system was developed to index screened chemicals and to correlate results from various test systems. To date, over 225,000 different chemical compounds have been screened for antimalarial activity. Most were provided by industry but more than 8,000 were synthesized specifically for this program. Recent emphasis was placed on synthesis and testing of new 8-aminoquinolines, which appear to have more preventive and curative potential than primaquine. More than 200 compounds were tested in subhuman primates and over 25 were tested in man. The current annual rate of compounds synthesis is 450; primary screening, 8,250 (8,000 curative, 250 prophylactic); advanced screening 250; toxicity testing and pharmacology, 3; Phase I and II clinical testing, 5; and field testing, 2. Mefloquine, a recently developed drug, proved effective against multi-drug resistant strains of falciparum malaria. For other investigations designed to gain a better understanding of drug mechanisms, methods for determining human blood levels of four different antimalarial drugs were developed. Highly purified immunoglobulin G, as well as other serum components obtained from immune animals, was shown to be active against murine malaria. Gamma irradiated sporozoites of murine malaria or red cells from rodents infected with murine malaria were used to immunize noninfected rodents. The latter were protected against subsequent challenge by the same parasite. A marked improvement in culture of falciparum malaria parasites has been achieved with maintenance of culture for several weeks when started with cryopreserved inocula. This information will be useful in developing an in vitro means of testing promising antimalarial drugs.

2. FY 1978 Program: Malaria drug development will continue on preparation and testing of selected compounds which are structurally related to drugs with known antimalarial activity. Special emphasis will be placed on developing antimalarials for use in preventing drug resistant strains of malaria. Clinical tests and limited field trials of nine different antimalarial drugs will be in progress during the year. Improvements of malaria drug screening system will be completed. Aminoquinoline drugs effective against resistant falciparum malaria will have toxicity levels determined. Recently developed animal models will be used during FY 79 in project A808 will be established.

3. FY 1979 Planned Program: Research program will be modified to completely integrate drug development activities for antiparasitic diseases such as malaria, leishmaniasis, and schistosomiasis. New program will provide more rapid development of drugs under project A803 and advanced human testing under project A808. Promising antiparasitic drugs for preventing malarial infection in man will be submitted to the Food and Drug Administration for approval. Additional drugs will be evaluated for treatment and/or prevention of leishmaniasis using the newly developed animal testing system. Procedures and animal models will be developed to evaluate prophylactic and therapeutic drugs against trypanosomiasis.

Project: #A803 — Title: Drug Development
Program Element: #6.27.70.A — Title: Military Infectious Diseases Technology
DoD Mission Area: #131 - Medicine and Life Sciences — Budget Activity: #1 - Technology Base

4. FY 1980 Planned Program: Research will be continued to develop more effective drugs for prevention and/or treatment of infectious diseases causing significant manpower losses during military operations. Previously developed screening and testing systems will be utilized to evaluate drugs for effectiveness as antimalarial, antischistosomal, antileishmanial and antitrypanosomal agents. One or two drugs will be evaluated under field conditions for prevention of leishmaniasis. Preclinical and clinical tests of an antitrypanosomal drug will be conducted.

5. Program to Completion: This is a continuing program.

6. Major Milestones: Not Applicable

7. Resources ($ in thousands):

	FY 1977	FY 1978	FY 1979	FY 1980	Additional to Completion	Total Estimated Cost
RDTE,A: FUNDS	7457	7682	7334	7524	Continuing	Not Applicable

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.71.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Military Psychiatry and Microwave Injury
Budget Activity: #1 - Technology Base

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimate Costs
	TOTAL FOR PROGRAM ELEMENT	2899	2620	2917	3242	Continuing	Not Applicable
A804	Military Psychiatry	2080	1720	1877	2095	Continuing	Not Applicable
A805	Microwave Injury	819	900	1040	1147	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program identifies and measures factors in the military environment such as combat stress and microwave radiation which may affect the combat effectiveness and health of the soldier, then proposes and tests preventive or corrective measures.

C. BASIS FOR FY 1979 RDTE REQUEST: The Army has a requirement for research to minimize the unfavorable effects of continuous military operations on personnel health and combat effectiveness. This requirement is based partially on increased emphasis being given to night operations with extended technological support such as night vision boosting devices. Microwave research provides the basis upon which the Army Surgeon General makes recommendations on protecting the health of military personnel exposed to radar and related electro-magnetic energy fields.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Future wars with continuous combat and little or no troop replacement will result in exhausted, sleep deprived soldiers. Methods which will maintain soldier effectiveness must be addressed. Such information is key to development of feasible battle operational plans. Previous combat experience has established that psychiatric casualties account for at lease one sixth of total battlefield casualties. When soldiers are exposed to weapons and tactics not encountered before, as they will be in any future conflict between major powers, the threat of psychiatric breakdown increases. An understanding of the fundamental factors producing psychiatric casualties, independent of specific technology and doctrine, is required to develop preventive measures and to determine means of restoring casualties to full effectiveness within 48 to 96 hours. Microwave systems currently employed or being developed by Army are rapidly expanding in number and diversity. What constitutes a significant hazard level of radiation to personnel exposed to these systems has not been adequately defined. Research on microwave radiation attempts to develop a meaningful data base from which realistic human exposure standards for military equipment must be established.

Program Element: #6.27.71.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Military Psychiatry and Microwave Injury
Budget Activity: #1 - Technology Base

F. RELATED ACTIVITIES: While there is a broad interest in and support of research dealing with psychiatric illness, stress induced performance decrements and microwave injury, the problems dealt with under this program element are military unique. An extensive network of formal and informal relationships with other governmental agencies and Army medical laboratories is maintained. US Army Medical Research and Development Command scientists participate in international study groups such as NATO's Advisory Group for Aerospace Research and Development and the Technical Coordination Program. Liaision observers sit on relevant study sections conducted by the Department of Health, Education, and Welfare. Collaborative studies of stress-induced performance decrements are conducted with the US Army Research Institute of Environmental Medicine and the US Army Aeromedical Research Laboratory. The US Army, Navy and Air Force have established a Tri-Service Electromagnetic Radiation Plan under the guidance of the Under Secretary of Defense for Research and Engineering. The plan is updated periodically and is intended to ensure the proper allocation of limited resources to the highest priority tasks and the Armed Forces Radiobiology Research Institute. In addition, Army maintains a program with Department of Defense/Electromagnetic Compatibility Analysis Center to keep apprised of Army special utilization and operational system configurations.

G. WORK PERFORMED BY: Ninety-two percent of the work is performed in-house at the Walter Reed Army Institute of Research, Washington, DC. Eight percent is performed on extramural contracts located at Westinghouse Electric Corporation, Baltimore, MD; University of Utah, Salt Lake City, UT; and Institute for Behavioral Research, Inc., Silver Spring, MD. Total contract funding is $198,000.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Completed study of distribution of psychiatric illness in Armed Forces from pre World War I to 1973. Collected and began analysis of data from extended operations studies using artillery teams. Established facility for epidemiologic studies of medical factors in soldier effectiveness in table of organization and equipment units stationed in Europe. Radically improved microwave electrodes developed for measuring temperature elevations in experimental animal and simulated human tissues during microwave exposure. Developed new method of measuring microwave exposures utilizing remote sensors. Studies relating to alterations in primate eye tissues and frequency of microwave radiation were accomplished. Human body characteristics such as body length and its orientation in a microwave field determined to affect the total amount of radiation absorbed by exposed humans. Microwave biophysical studies at the cellular and molecular levels initiated. Behavioral effects of microwave radiation identified in rodents.

N. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS: (Cont)

2. FY 1978 Program: Analysis of data from FY 77 studies of extended operations with fire direction center (FDC) model will be completed. This analysis is expected to reveal the utility of the FDC model in future studies of continuous operations. Studies are planned to identify factors such as organizational structure which influence the incidence, prevalence, and distribution of psychiatric disease. Epidemiologic studies of psychiatric factors in soldier effectiveness will be extended to table of organization and equipment units stationed in Europe. Wireless method of transmitting data from implanted heat sensing microwave electrodes to various recording systems will be developed. Remote microwave sensor techniques will be utilized to study the relationships between internal energy distribution in simulated human tissues and microwave characteristics. Microwave biophysical studies at cellular and molecular levels will assist in the prediction of biohazards from Army microwave systems. Study of the unique hazards of pulsed microwave radiation emitted by Army operational radars will be initiated. Development of an implanted electrode to detect induced electrical fields in simulated human tissue will be initiated.

3. FY 1979 Planned Program: Field studies are planned to define health and disease factors associated with rapid deployment of units. Concepts of neuroendocrine mechanisms of stress responses will be refined. Studies focusing on soldier effectiveness under conditions of continuous operations will be expanded, ranging from in-house basic research to participation in field exercises. Wireless heat sensing microwave electrodes will be employed to detect temperature elevations in the eyes and brains of irradiated animals. Remote microwave sensors will be used to study energy distribution within isolated animal organs exposed to microwave radiation. Pulsed microwave studies will continue with emphasis on pressure waves induced within simulated human tissues by high energy pulses. Work on wound healing will continue through study of effects of microwave on specific human body cells which promote such healing.

4. FY 1980 Planned Program: Emphasis of the program will be on collation of FY 77-79 multi-lab research results regarding mental and physical fitness for duty. Factors which predispose or protect against psychiatric breakdown in mass casualty situations will be identified for application to combat settings. Principles for management of psychiatric casualties will be evaluated for applicability to high mobility operations and high intensity combat conditions. Remote microwave sensors will be utilized to explore methods of three-dimensional mapping of energy absorption in simulated human tissue. Other ongoing studies will be continued.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.72.A
DoD Mission Area: #131 - Medical and Life Sciences

Title: Recovery from Injury
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7212	7471	3790	1445	Continuing	N/A
AB10	Military Skin Disease	1019	1462	238	0	0	N/A
AB11	Military Nutrition and Food Hygiene	1496	1121	0	0	0	N/A
AB12	Military Research Animal Resources	485	601	655	0	0	N/A
AB13	Health Effects of Military Lasers	1025	1102	0	0	0	N/A
AB1A	Military Trauma and Resuscitation	2834	2629	2290	0	0	N/A
AB15	Combat Surgery	353	556	607	1445	2588	N/A

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Research and development objectives are to save wounded soldiers and return them to duty, to determine, prevent and treat biological effects of laser radiation, to develop prophylaxis and treatment of skin disorders occurring in the combat environment, to improve insect repellents, to establish combat nutritional requirements, and to establish colonies of essential research animals.

C. BASIS FOR FY 1979 RDTE REQUEST: To continue those ongoing intra- and extramural research efforts which have the highest priorities for RDTE funding and are considered essential for mission accomplishment. These efforts include completion of ongoing studies of dermatologic disease, insect repellents and essential research animals, and continuation of studies for patient resuscitation and improved management of trauma casualties. Nutrition and laser studies will no longer be conducted as part of this program element.

D. OTHER APPROPRIATION FUNDS: NONE

Program Element: #6.27.72.A
DoD Mission Area: #131 - Medical and Life Sciences

Title: Recovery from Injury
Budget Activity: #1 - Technology Base

E. DETAILED BACKGROUND AND DESCRIPTION: This is a multiple program.

a. The intimate association of the combat soldier with the environment sets the stage for a multitude of skin disorders otherwise rarely encountered. Research into the pathogenesis of skin disorders, their prevention via anti-fungal vaccines or physical measures and their treatment is of primary importance. Development of new and improved insect repellents is the most feasible preventive measure available in mobile combat operations for diseases transmitted by insect vectors.

b. Nutrition and food wholesomeness research is required to maintain well fed, healthy soldiers both in peace and war. Research conducted to determine normal nutrient requirements and requirements in cases of disease, injury, and stress. Research also performed to assess wholesomeness requirements of military subsistence needed to protect and maintain combat health.

c. To preclude abolishment of crucial research programs involving primates the Army must establish primate breeding colonies.

d. Energy output and associated aspects of all military laser systems must be studied to develop protective means and determine safety factors. Studies are designed to determine exposure thresholds of radiation from military lasers at which ocular and skin injury occur.

e. The major cause of mortality in warfare is trauma. The requirement for improved methods of resuscitation and treatment of the combat injured soldier with the aim of prompt return to duty without permanent disability or disfigurement is of the highest priority. Research is carried out at the basic laboratory level and the clinical level in the areas of cellular, organ and systems response to trauma; tendon, nerve and bone repair following injury; wound healing; intermediary metabolism and nutrition; infectious complications of trauma; blood preservation and blood substitutes; and the effects of massive transfusion.

F. RELATED ACTIVITIES: Related nonduplicative research is conducted by other government agencies, institutes, universities, and other federal services. Continual coordination and review of related research by technological summaries, periodic program reviews, joint medical research conferences, literature review, etc., insures that there is no duplication at the work bench level.

G. WORK PERFORMED BY: Approximately 56% of the work is performed by in-house laboratories at Letterman Army Institute of Research, San Francisco, CA and the Walter Reed Army Institute of Research, Washington, DC. Major extramural contracts are with the Harvard University School of Public Health, Boston, MA; Yale University, New Haven, CT; New York University, New York, NY; Ohio Wesleyan University, Delaware, OH; University of Louisville, Louisville, KY; a total of 38 contracts are supported at a total cost of $3,313,000.

Program Element: #6.27.72.A
DoD Mission Area: #131 - Medical and Life Sciences

Title: Recovery from Injury
Budget Activity: #1 - Technology Base

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 77 and Prior Accomplishments: Animal models were developed for immunologic investigations of fungal infections. Topically applied anti-fungal agents and insect repellents were evaluated. Microbiological standards for several food products were established. Nutritional surveys at Navy, and Air Force installations were performed. Several nutritional factors were evaluated for military personnel such as nutritional status, effects of stress on nutritional requirements and nutrient requirements by age, sex and activity level. Monkey breeding programs were established in-house. Animal models were developed to characterize eye and skin injuries resulting from laser exposure in order to determine effects of wavelength, pulse duration, and retinal sensitivity upon laser damage threshold levels. Both a new blood substitute, stroma-free hemoglobin, and a new blood preservative were developed. An improved tendon prosthesis was developed and improved segmental replacement for long bone loss was investigated. Metabolic and endocrinologic alterations in shock and trauma and nutritional support requirements for injured soldiers were identified.

2. FY 1978 Program: Developmental efforts for an anti-fungal vaccine will be continued and skin characteristics related to host resistance and susceptibility to fungal and other skin diseases will be identified. Evaluation techniques will be improved and employed for primary and advanced screening of promising insect repellents. Nutrition and food wholesomeness studies will be completed, terminated or transferred to other program elements by the end of this year as a result of FY 79 funding decrements. In-house breeding of owl monkeys will be increased. Microscopic examination will be made to determine if eye and skin alterations are produced by "safe level" exposure to laser radiation. Laser research will be transferred to other program elements by the end of the year. Testing and licensure of an improved blood preservative will be accomplished. Studies of platelet storage, endotoxin antiserum, tendon prosthesis, and long bone replacements will be continued. Characterization of system, organ and cellular response to injury will be accomplished and new techniques to enhance shock recovery and wound healing will be developed.

3. FY 1979 Planned Program: Anti-fungal vaccine studies will be completed. Insect repellent compounds will continue to be evaluated pending transfer of these efforts to another program element by the end of the year. In-house breeding of owl and rhesus monkeys will be continued pending transfer of these efforts to another program element by the end of the year. Human tests of stroma-free hemoglobin solution will be initiated. New techniques will be applied toward lengthening blood and blood product storage periods to 42 days. Multiple studies will be continued to improve transfusion techniques and procedures. Applications of electro anesthesia will be developed. Efforts will be made to understand and correct hormonal and metabolic derangements occurring as a consequence of trauma.

4. FY 1980 Planned Program: All dermatology, nutrition, experimental animal, and laser research will have been completed, terminated or transferred to other program elements by FY 80. Military Trauma and Resuscitation, project 814 and Combat Surgery, project 815, will be continued under one title as project 815, probably as part of a new program element. These changes reflect major programmatic curtailments and realignments which are being planned as cost reduction efforts in the face of decreasing budgets and emergence of new medical research requirements.

Program Element: #6.27.72.A
DoD Mission Area: #131 - Medical and Life Sciences

Title: Recovery from Injury
Budget Activity: #1 - Technology Base

5. Program to Completion: Not Applicable

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: 62.27.79.A
DoD Mission Area: #151 - Medicine and Life Sciences

Title: Helicopter Combat Crew and Airborne Medicine
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1839	3476	2211	2450	Continuing	Not Applicable
A818	Medical Effects of Blast Overpressure	0	1450	0	0	Not Applicable	Not Applicable
A819	Helicopter Combat Crew and Airborne Medicine	1839	2026	2211	2450	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Program studies of biomedical aspects of man-machine-environment relations in the employment of Army aviation, airborne operations, and crew-served combat vehicles will be conducted. Concerned primarily with identification and assessment of developmental equipment-generated health hazards and their effect on individual and crew performance. The effects of intravehicular environmental factors, e.g., noise, shock, vibration on the safety and well-being of the soldier are studied.

C. BASIS FOR FY 1979 RDTE REQUEST: Program is vital to the Army's combat readiness and success. Provides medical input for safe equipment design, provides rationale for protective clothing and equipment, and enhances soldier survivability and performance.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DISCUSSION: As combat capability of new weapons systems increases, new tactics and doctrine for employment developed, and more realism in combat training achieved, increased stress is placed on the individual soldier and combat crewman to the extent that weapons systems and techniques for employment may exceed the physiological, physical, and perceptual, psychomotor, and psychological capacities of the soldier. Without exception, every developmental weapon, and most already fielded, present health hazards to the crew operator, which may be temporarily or permanently disabling. Medical research meets a requirement to ensure the safety of the soldier, enhance his effectiveness, and protect his health. Research includes performance measures and workload assessment under training conditions, analysis of acoustic environments of weapons, bioengineering of air and ground combat vehicles and life support equipment, study of eye protection technology and vision enhancement, and aviation/combat crew medicine.

F. RELATED ACTIVITIES: Technology transfer and research coordination exist through intra-Army and Tri-Service agreements, regulations, and informal meetings to mutually complement joint requirements. Medical research is keyed to weapons systems Project Manager milestones. As an example, medical technology in research of aviation problems in the Army is specifically related to some Air Force and Navy aviation medicine requirements and is also transferable into technology for solution of armor and artillery problems.

G. WORK PERFORMED BY: Ninety-two percent of the work is performed in-house at the US Army Aeromedical Research Laboratory, Fort Rucker, AL. Eight percent is performed by extramural contracts to the Armed Forces Institute of Pathology, Washington, DC; Louisiana State University, Shreveport, LA; Texas Technological University, Lubbock, TX; and University of California, Berkeley, CA. Total contract funding is $162,000.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: The Life Support Equipment Retrieval and Failure Analysis program provided technology for product improvement of the SPH-4 flyer's helmet and medical evaluation of the Personnel Armor System for Ground Troops helmets. This technology is also provided continued assessment of vibration problems associated with helmet mounted sights. Visual distortion, depth perception, and field of view analysis of M-20 Protective Mask indicate it is unacceptable for use by aviators. Studies indicate some stabilized viewing devices and imagery presentation may exceed perceptual capacity of the soldier. Biomedical evaluation of high speed rescue hoist, UH-60A Blackhawk helicopter and visual requirements for tank gunners were completed. Study of physiological adequacy of airborne oxygen generating equipment begun. Biomedical evaluation of the AH-64 Advanced Attack Helicopter continued. A mathematical model for heat flux transfer through protective clothing was 2/3 completed. Technology was developed for utilization of night vision goggles during night flying simulation tests.

2. FY 1978 Program: Research will continue in major areas of concern. The XM-1 Main Battle Tank will be evaluated for a variety of potential health hazards. Seating position Test Vehicle will be evaluated to develop a data base for physiological effects of speed and vibration upon personnel in tracked armored vehicles. Research will continue in efforts to develop combat weapons system compatible eyewear, study performance design for night operations, and examine sustained and continuous workloads for aircrews.

3. FY 1979 Planned Program: Program centers around efforts to identify hazards to crewmen in combat vehicles and expand the physiological and psychological data base to assess the impact of these hazards on performance. Methods will continue to be sought to eliminate or reduce health hazards through medical input to engineering design. Emphasis will continue in assessment of operations during naturally or artificially induced reduction of visibility, and biomedical problems anticipated in combat in built-up areas. Research will provide biomedical input to standards for vibration and impact in tracked armored vehicles. Biomedical evaluation of XM-1 Tank and Infantry Fighting Vehicle will continue to develop a medical data base. Bioengineering of crew station design in developmental combat vehicles will be of paramount concern.

Program Element: #6.27.73.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Helicopter Combat Crew and Airborne Medicine
Budget Activity: #1 - Technology Base

4. FY 1980 Planned Program: Medical assessment will continue in areas of air mobility, crew served vehicular weapons systems, and new doctrine and tactics. Studies of effects of fatigue, rest cycles, and combined environmental stressors on crew performances should be well under way. Programs will expand to encompass biomedical parameters for crew selection and studies of personnel failure in training and combat. Physiological effects of fighting from enclosures and sensory isolation will be matters of concern.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.74.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Military Burn Technology
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	747	657	717	0	Not Applicable	Not Applicable
A820	Military Burn Technology	747	657	717	0	Not Applicable	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Objective of this program is to conduct basic laboratory and clinical research in the following areas for treatment of the burn-injured soldier: metabolism and nutrition, alterations in pulmonary function and pulmonary complications, altered immune status and response to infection, wound care and healing, cardiovascular, gastrointestinal and renal effects of burn injury. The mission need lies with the frequency of burn injury to the combat soldier, its attendant complications, and the need to reduce the morbidity and mortality from burn injury.

C. BASIS FOR FY 1979 RDTE REQUEST: Continuation of the in-house and extramural laboratory and clinical research programs related to definitive care of the burn-injured soldier in order to reduce morbidity and mortality from such injuries and to extend the scientific base upon which improved treatment methods are developed. Specific areas of investigation will be improvement of resuscitation and monitoring techniques, prevention and control of infection and sepsis, organ failure and metabolic effects of burn injury.

D. OTHER APPROPRIATION FUNDS: Not Applicable

E. DETAILED BACKGROUND AND DESCRIPTION: This program involves the comprehensive, continuous development of improved diagnostic modalities, clinical surgical procedures and ancillary medical techniques to solve the problems that contribute significantly to mortality and morbidity in burn-injured soldiers, such as shock, sepsis, wound healing, metabolism and organ failure. After problem areas are identified and new techniques developed in the laboratory, they are evaluated and further developed in the clinical setting.

F. RELATED ACTIVITIES: Army studies related to this program are performed under Program Element Project 6.11.02.A/B805, Military Burn Research. Related nonduplicative research is conducted by burn centers in the United States at various institutes and universities as well as by the US Navy and Air Force. Continual coordination and review of related research by technology summaries, periodic program reviews, joint medical research conferences, literature review, etc., insures that there is no duplication at the work bench level. The personnel of the in-house laboratories are regarded as prominent scientists in research today and are sought after as lecturers and consultants and remain continually abreast of all meaningful research.

Program Element: #6.27.74.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Military Burn Technology
Budget Activity: #1 - Technology Base

G. WORK PERFORMED BY: Approximately 59% of the available funds supportthe Army in-house research programs conducted at the US Army Institute of Surgical Research, Fort Sam Houston, TX. Major extramural contracts are with Newark Beth Israel Medical Center, Newark, NJ; Institute for Medical Sciences, San Francisco, CA; University of California, San Diego, La Jolla, CA; University of California, San Frencisco, San Francisco, CA: Harvard University, Boston, MA; New York University, NY, NY; St. Judes Hospital, Memphis, TN.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Prior accomplishments include the following; revision of the fluid formula used in resuscitation, use of the echocardiograph in monitoring valvular endocarditis, improved clinical diagnosis of inhalation injury and identification of "at risk" population, description of post burn hyper metabolism and identification of mediators, with development of an experimental model simulating the clinical situation, description of changes in the immune system following burn injury, use of the agent Sulfamylon for control of burn wound bacteria, verification of the usefulness of new techniques of excision of the burn wound and of biopsies to determine bacterial invasion, description of gastrointestinal ulcers in burn patients and the role of intragastric buffering agents in reducing agents in reducing their development.

2. FY 1978 Program: Objectives include: further refinement of fluid therapy, development of noninvasive cardiac monitoring techniques; evaluation of inhalation injury in an experimental model; evaluation of new antibacterial topical agents, assessment of the effects of isolator environments on wound contamination and infection, effect of thermal injury on organ and tissue metabolism, assessment of effectiveness of broad spectrum gram negative antiserum, evaluation of experimental models for renal failure and stress ulcers, verification of effectiveness of new agents for ulcer prophylaxis.

3. FY 1979 Planned Program: Studies will be continued to optimize fluid therapy and resuscitative techniques; develop monitoring techniques for cardiovascular and pulmonary status; develop improved methods to evaluate effectiveness of current methods of treatment and prevention of burn wound infection and sepsis; determining cellulary, organ and system effects of thermal injury and postburn sepsis. All work will be completed, terminated or transferred to another program element at the end of the year as a result of program realignments.

4. FY 1980 Planned Program: Research activities performed under this program element will be completed, terminated or transferred to another program element by FY 1980 as a result of program realignments.

5. Program to Completion: Not Applicable

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.75.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Combat Maxillofacial Injury
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1048	1155	1260	1339	Continuing	Not Applicable
AB25	Combat Maxillofacial Injury	1048	1155	1260	1339	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The extremely high intensity of conflict due to revolutionary weapons' development causing a dramatic increase in maxillofacial injuries coupled with the shortage of adequately trained immediate replacements early in a combat operation requires maximum research effort to rapidly return troops to duty to maintain effective combat strength. It is also essential to vigorously pursue research efforts in prevention of dental disease to assure that the soldier is not lost to his unit due to conditions which could have been prevented through proper oral health care management. These research efforts for improved professional care must be pursued and intensified to develop better materials, methods, and definitive management of combat injuries.

C. BASIS FOR FY 1979 RDTE REQUEST: Continuation of both short and long term in-house and extramural studies which are acquiring information necessary to solve problems both in providing improved care of maxillofacial combat injuries.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The high incidence of combat maxillofacial injury, the increase in traumatic injury and oral disease with their associated trend of higher treatment costs dictate research targeted toward time/treatment goals to reduce duty time lost and to rapidly return injured troops to duty. Areas of investigation include materials for immediate and delayed restoration of combat maxillofacial wounds, improved means of administering analgesia to the dental complex in a combat area and development to save the limited military funds by increasing productivity of dental professionals, improved immediate treatment in combat areas, decreased morbidity, increase quality of care and decrease the clinical treatment and hospitalization time.

Program Element: 6.11.02.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Combat Maxillofacial Injury
Budget Activity: #1 - Technology Base

F. RELATED ACTIVITIES: Army studies related to this program element are performed under Program Element Project 6.11.02.A/BS06, Combat Dental Materials and Techniques. Related, but nonduplicative research is conducted by the US Navy, Air Force, and the National Institute of Dental Research. Coordination of research is achieved by consultations between participants, project officer visits, review of research and technology summaries, periodic program reviews, and reviews of scientific publications both military and civilian. In addition, liaison memberships are held on the National Advisory Dental Research Council and the Oral Medicine and Biology Study Section, National Institute of Dental Research.

G. WORK PERFORMED BY: Approximately 50% of the funds support the only Army in-house research effort, the US Army Institute of Dental Research, Washington, DC. The remaining funds are used for extramural contracts. Contractors receiving funds are: University of Oregon, Portland, OR; University of Illinois, Chicago, IL; Battelle Memorial Institute, Columbus, OH; Polymer Research Corporation, Brooklyn, NY; and Edgewood Arsenal, Aberdeen Proving Ground, MD. Eight contracts are supported for an extramural program of approximately $577,000.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Studies addressing biodegradable copolymers and their degradation rates, tissue compatibility and animal technique phase for various surgical procedures were completed and are awaiting the Food and Drug Administration approval for continuation in other models. Optical recording vitalometer was converted to sound activated identifying form and prepared for testing. Supplemental presurgical handwasher studies were completed with recommendations. Less expensive replacements for militarily unique dental restorative materials were investigated. Human biodegradable ceramic investigations were continued to obtain additional and statistically significant data. Developed new, more effective cold sterilizing agent and techniques. Initiated new project to develop biocompatible material for tissue augmentation in avulsive maxillofacial combat wounds. Initiated new project to determine most effective fluoride compounds for tropical application to prevent needless dental emergencies in combat situations.

2. FY 1978 Program: Initiate major human studies using electroless metal plating to confirm animal applications in reducing dental emergencies in areas of deployment or combat. Complete prosthetic insertion phase and the continuation of human studies using metallic tooth implants both as a fracture fixation device and single tooth replacement. Continuation of animal studies using biodegradable copolymers to show the potential of this material for long term drug administration. Continuation of past studies addressing the surgical management of combat wounds using biocompatible ceramic tooth implants to achieve both comprehensive animal data and definitive evaluation of a newly designed infrastructure. Continuation of project in 3-dimensional imagery for treatment and replacements to reduce post surgical hospitalization time and soldier morbidity. Initiation of project to study the effects of ultrahigh velocity missile wounds in the maxillofacial complex. Initiation of studies to develop field salivary diagnostic tests for detection of chemical agents. Continuation of project to provide rapid determination of specific bacterial contamination in combat wounds.

Program Element: #6.27.75.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Combat Maxillofacial Injury
Budget Activity: #1 - Technology Base

3. FY 1979 Planned Program: Continuation of human studies with metallic implants both as a fracture fixation device and a single tooth replacement. Continuation of studies in 3-dimensional imagery for identification of combat fatalities and transmission of data for more rapid surgical treatment of avulsive wounds. Animal and human studies with electroless metal plating will address new applications and even easier techniques for preventive and restorative utilization in the combat soldier. Extensive material characterization both biodegradable and nondegradable, will form basis for future study. Continuation of studies to identify specific organisms in combat wound contamination.

4. FY 1980 Planned Program: Human studies will continue utilizing ceramic and sintered titanium implants both as fracture fixation devices and single tooth replacements. Exploration of additional uses of 3-dimensional imagery in diagnosis and treatment of avulsive maxillofacial wounds. Continuation of studies into ultrahigh velocity missile wound effects. Continuation of studies in utilization of lasers in combat maxillofacial wound surgery. Continue characterization of biodegradable/biocompatible materials for maxillofacial use. Extensive studies must address chemical agent detection in combat situations through salivary test. Continue wound healing studies and determination of combat wound contaminants.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.27.76.A

Title: Medical Defense Against Biological Agents

DOD Mission Area: #135 - Chemical Biological Warfare Technology Base

Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING) ($ in thousands):

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	6453	7663	7564	8891	Continuing	Not Applicable
A841	Medical Defense Against Biological Agents	6453	7663	7564	8391	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Objective of this program is to develop an effective medical defense against biological weapons through research on the pathogenesis of potential biological agents, rapid laboratory identification of agents, and prevention and treatment of biological agent casualties which include vaccine development, production and stockpiling.

C. BASIS FOR FY 1979 RDTE REQUEST: Concentrated research efforts are necessary to further advances in prevention of biological casualties and to develop new methods of diagnosis and treatment. Expansion of vaccine production and test programs are required to improve predevelopment immunization capabilities against most likely biological warfare (BW) agents. A highly important element is the continuing capability for the mass production of vaccines developed at US Army Medical Research Institute of Infectious Diseases, which is imperative for a rapid response to a BW threat or infectious diseases endemic in an area of military operations.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Improved techniques are sought for mass production of vaccines against known and potential biological weapons. Improved methods are sought for rapid, early laboratory identification of infectious diseases, as well as better methods for prevention or treatment of those diseases that pose a biological agent threat. Aerobiology studies to achieve aerosol immunization and protection systems against biological warfare and other hazardous infectious diseases are a significant part of the program.

F. RELATED ACTIVITIES: Related Army studies are performed under program elements/projects 6.11.02.A/BS01, Basic Research on Military Injury and Diseases; 6.11.02.A/BS03, Medical Defense Against Biological Agents; and 6.27.70.A/A802, Military Preventive Medicine and Tropical Diseases. This program provides the major input in the national program for medical defense against biological agents. General infectious disease research conducted by the Navy and National Institutes of Health is pertinent to this program. Coordination is accomplished by personal contacts at the operating level, technical symposia, and regular exchange of documents for review, which avoids unnecessary duplication of efforts.

Program Element: # 6.27.76.A

Title: Medical Defense Against Biological Agents

DOD Mission Area: #135 - Chemical Biological Warfare Technology Base

Budget Activity: #1 - Technology Base

G. WORK PERFORMED BY: Approximately 77% of the work is performed by the US Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD, and 23% by extramural contractors including Merrell-National Laboratories, Cincinnati, OH; Yale University, School of Medicine, New Haven, CT; and Washington State University, Pullman, WA. Total amount of contract funding is $1,762,000.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Vaccines were developed against Rift Valley fever (RVF), Q fever, tularemia, chikungunya virus, plague, Eastern (EEE), Western (WEE) and Venezuelan (VEE) equine encephalomyelitis and evaluated in volunteers. Mode of action of staphylococcus enterotoxin was studied and an experimental toxoid using fragments from the molecule prepared. Utilizing currently available methods of improving VEE and EEE vaccines, significant progress was made in developing other arbovirus vaccines. A new rapid identification procedure was developed for VEE, WEE and EEE viruses that eliminated the cost of utilizing laboratory animals and significantly reduces the time required for virus identification. Quantitative doses of immune serum and gamma globulin were determined for prevention and early treatment of Bolivian hemorrhagic fever in monkeys. An improved Rocky Mountain spotted fever (RMSF) vaccine was developed and underwent preliminary evaluation in laboratory volunteers. Development of an inactivated Venezulelan equine encephalomyelitis (VEE) vaccine was completed. New antiviral drugs (poly I.C. rimantidine and ribavirin) have proven highly effective in prevention and treatment of influenza. Laboratory disease animal models have been developed in order to study infectious disease, develop therapy procedures, and preventive measures. These include swine influenza, RMSF, and Bolivian Hemorrhagic fever (BHF). A new diagnostic assay designed to measure lymphocyte subpopulations has been highly effective in evaluating the immune response to viral infections and particularly in evaluating cellular responses to vaccines. A hexavalent Botulinum toxoid development was initiated. Causative agent of Korean hemorrhagic fever (KHF) was isolated.

2. FY 1978 Program: Animal testing of new BHF vaccines is being initiated, with increased emphasis placed on applied studies in animals of several very promising antiviral chemotherapeutic compounds. These compounds, due to their rapid preventive as well as therapeutic nature, are prime candidates for usage in early phases in military operations. Development of toxoids for Botulinum continues. Program for developing new vaccines to anthrax, Congo/Crimean Hemorrhagic fever and Ebola virus is being initiated and effectiveness of new rapid diagnostic techniques previously developed for various infections of military importance evaluated.

3. FY 1979 Planned Program: Final development of a BHF vaccine is anticipated. Emphasis will be placed on completion of the development phase of a hexavalent Botulinum toxoid and development of vaccines to newly identified hemorrhagic diseases (Ebola and KHF) of great biological warfare (BW) potential and which are receiving unusual interest by leading scientists of the Eastern bloc countries. Studies will continue on preventive therapeutic and diagnostic procedures of other high risk potential BW agents. These studies will be initiated on the causative agent of Legionnaires' Disease.

4. FY 1980 Planned Program: Initial human testing of the Botulinum toxoid and animal testing of candidate Ebola and Lassa fever vaccines will be accomplished. Korean hemorrhagic fever and Congo/Crimean hemorrhagic fever vaccine development will be continued. Initial development of a vaccine against Legionnaires' Disease will be started.

Program Element: # 6.27.76.A

Title: Medical Defense Against Biological Agents

DOD Mission Area: #135 - Chemical Biological Warfare Technology Base

Budget Activity: #1 - Technology Base

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: 6.27.77.A
DoD Mission Area: #131 - Medicine and Life Sciences

Title: Military Environmental Stress
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING) ($ in thousands):

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2287	2321	4552	2925	Continuing	Not Applicable
A845	Military Environmental Stress	2287	2321	4552	2925	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Conduct research to determine how heat, cold, high terrestrial elevation, work, and physical fitness affect soldiers' life processes, performance, and health; develop methods for avoiding performance degradation and for treatment of diseases produced by climate extremes; and develop toxicological data base required by US regulatory agencies for credible health hazard evaluation of smokes, obscurants, and other occupational chemicals.

C. BASIS FOR FY 1979 RDTE REQUEST: Program provides scientific, medical, and technological information on physical, physiological and psychological responses of man to environmental stresses of heat, cold, high terrestrial altitude, and high workload. Targets are enhancement of troop performance and protection and treatment of injuries occurring in harsh environments. Likelihood of arctic operations necessitates efforts for cold environments. Similar likelihood for desert and Middle East combat requires efforts for hot environments. High altitude is a stress for most candidate battlefields. Complete integration of women in the Army requires additional efforts in physical standards, physical training impact on health, morale, job performance, and physical training standards. Research on occupational health hazards, e.g. exposure to smokes, obscurants, and industrial environments for munitions production, is based on (1) compliance with occupational protection law and legal milestones through multiyear research, and (2) pacing development of required data base with development of new smokes and obscurants to preclude large expenditures for medically unacceptable components.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: One objective is to maintain soldier effectiveness in any combat environment. This includes developing improved preventive techniques and treatment methods for diseases produced by environmental extremes. Research targets include but are not limited to (1) definition of complex environmental stress effects on the human body, and (2) definition of physical fitness requirements to meet environmental stress. A new (FY 78) objective is protection of the munitions workforce exposed to Army-unique or Army-relevant chemicals affecting health. Targets include new compounds considered for inclusion in new smokes and obscurants, compounds such as nitroglycerine showing evidence of occupational harm potentially leading to costly compensation litigation, and compounds resulting from manufacture of other munitions.

F. RELATED ACTIVITIES: Program elements/projects 6.11.02.A/B808, Military Environmental Stress; 6.11.02.A/B501, Research on Military Injuries; 6.11.02.A/B804, Identification and Health Effects of Military Pollution, and 6.27.20.A/A835, Military

Environmental Quality. These elements share many common technologies, but the problems they address differ widely. Technology transfer is accomplished by study groups and work shops, both in-house and intra-service.

G. WORK PERFORMED BY: About 96% of the work is performed in-house at the US Army Research Institute of Environmental Medicine, Natick, MA; Walter Reed Army Institute of Research, Washington, DC; US Army Medical Bioengineering R&D Laboratory, Fort Detrick, MD and Chemical Systems Laboratory, Aberdeen Proving Ground, MD. Total contract funds are $101,000.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Dose-response curves in rats suggested that working to exhaustion lowers the threshold for heat stroke mortality and cellular injury; rapid change in key serum enzymes and electrolytes are grave prognostic indicators. It was determined that groups of heat sensitive and heat resistant animals could be identified. Work-related factors contributing to an increased rate of heat stroke mortality at low thermal loads were evaluated. Women entering the Army were found to have 25% less stamina and 25-50% less muscle strength fitness. Lower fitness in women is due largely to higher body fat content and not to inferior quality of muscle. Women showed improvement in fitness when given male training programs. Treatment and evaluation of casualties under cold weather conditions resulted in recommendations to modify doctrine for structure, equipment, and training. Preliminary work was completed on assessment of methods to improve peripheral circulation during and following cold stress. Mild dehydration was shown to increase the likelihood of cold injury. Studies of self-paced mobility over snow led to a predictor of troop mobility as a function of snow depth. Studies were begun with reprogrammed funds to determine standards for soldier performance and health and environment effects of candidate smoke obscurant components.

2. FY 1978 Program: Previous results established dose-response curves for heat-induced mortality based on time and intensity of body heating. Current results indicate prehydration and adequate plasma volume replacement during heat exposure can forestall acute lethal hyperthermia. Efforts are directed toward elucidating the biophysical, physiological, and biochemical bases for these results; determine physical fitness requirements for entry into service and job qualifications; continue investigations on arm exercise as a method of hand rewarming; assess conditional methods for inducing peripheral vasodilation in the cold; assess the effects of cold air breathing on respiratory mechanics with human subjects; perform field epidemiologic studies during winter exercise Empire Glacier (Fort Drum, NY) and Jack Frost (Fort Wainwright, AK); evaluate hyperthermic pig model; study fluid therapy for hypothermics; evaluate existing hearing protection devices for the M198 cannon; explore indices by which susceptibility or resistance to debilitating effects of acute high-altitude exposure can be determined; test current doctrine on water requirements for operations in hot environments; study performance degradation and heat stress incurred by armored vehicle crewmen in hot environments; develop method of prediction of unit mission performance requirements and a prospective health effect assessment of smoke and obscurants components; and continue establishment of toxicological data base for occupational standards for exposure to military chemicals.

3. FY 1979 Planned Program: Reflects increased emphasis on areas of FY 78 research results that prove to be of greatest importance to operational requirements. Studies in the major research areas of military performance, human adaptations to climate

and related stress, biophysics of clothing, and the pathophysiology of environment-induced disease will continue, as will sustained analysis of physiology of physical training. Major activities will begin for aiding the establishment of criteria and standards for exposure to smoke/obscurant and munitions chemicals to include the training and manufacturing environments.

4. FY 1980 Planned Program: Specific targets for FY 80 will depend on results generated during FY 79 and FY 80. Long-term toxicological studies started in FY 79 will continue for occupational standards for chemical exposures.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.78.A

Title: Combat Medical Materiel

DoD Mission Area: #131 - Medicine and Life Sciences

Budget: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1272	1402	1531	1628	Continuing	Not Applicable
A838	Combat Medical Materiel	1272	1402	1531	1628	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Development of medical equipment required to support the health care delivery system in the field and under combat conditions.

C. BASIS FOR FY 1979 RDTE REQUEST: Continue and increase efforts to design and fabricate new pharmacy equipment based on results of requirements identified by field pharmacy study; i.e., communications, quality control, and drug distribution equipment. Technical, operational, and practical evaluations of sterilization equipment will be undertaken. A significant secondary effort will be made to modify present equipment and disseminate information to field units, essential to improve their existing sterilization equipment, techniques, and procedures. Further development effort will focus on whole body diagnostic and recording systems, field dental equipment, and water purification systems.

D. OTHER APPROPRIATION FUNDS: NONE

E. DETAILED BACKGROUND AND DESCRIPTION: A reliable and efficient casualty treatment system during wartime is essential to maintain combat strength. Doctrine for modern warfare and new weapon developments increased the problems and complexity of diagnosing and treating large numbers of combat injuries. This requires an aggressive experimental research effort to develop new and improved medical field equipment to provide quality medical care to the soldier in the field. This program will develop field medical equipment in areas such as laboratory determinations, dental operating sets, sterilization of supplies, whole body x-ray, pharmacy, eye examination, insect detection and control, field sanitation, and patient handling.

F. RELATED ACTIVITIES: There is no duplication of effort in this program element. Related studies are performed under Program Elements Projects 6.37.32.A/836, Combat Medical Materiel and 6.47.17.A/832, Combat Medical Materiel.

Program Element: #6.27.78.A

Title: Combat Medical Materiel

DoD Mission Area: #131 - Medicine and Life Sciences

Budget Activity: #1 - Technology Base

G. WORK PERFORMED BY: Fifty-four percent of the work is performed in-house at the US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD. Forty-six percent is performed by major extramural contracts at the Castle Company, Rochester, NY: University of California, Berkeley, CA: High Voltage Engineering, Incorporated, Burlington, MA; Optical Sciences Group, San Rafael, CA: and the United States Department of Agriculture Research Laboratory, Gainesville, FL. There is a total of six contracts, which constitute $645,000.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: A prototype Automated Ophthalmic Refraction System was installed and tested at Letterman Army Medical Center. Tests demonstrated the feasibility of providing optical prescriptions for 90-96% of the military population. A prototype instrument for Objective and Automated Measurement of Visual Acuity was successfully utilized in a test environment at Letterman Army Medical Center. A contract was formalized on the Army Life Support Power System for Environmental Control of Casualty Holding and Evacuation Bags to continue development of a heat source. A requirement document has been initiated on the Field Clinical Analysis System. Development actions for a Field Dental Compressor-Dehydrator Dental Operating and Treatment Unit, and Light/Tray/Stool Unit were completed and progressed into engineering development. Feasibility investigation of alternative items of modular cabinetry for a "family" of dental sets was completed, materiel concept for a self-contained, electrically powered field dental operating unit was approved and fabrication of an experimental prototype was initiated. Operational testing was conducted on a second generation prototype of the Pulsed Water Pressure Device for Arm and Hand Washing at the US Army Institute of Dental Research. Prototype fabrication of all processing equipment completed and delivered under exploratory development to conclude Phase II of the Field Sterilization Study. The equipment (a power supply for heating the casualty evacuation bag) provided by Energy Systems Incorporated, was evaluated at the Army Natick Research and Development Command and the US Army Medical Bioengineering Research and Development Laboratory. Satisfactory evaluation of the equipment indicated that developmental efforts should be continued to further adapt it for Army use.

2. FY 1978 Program: Prototypes of the field sterilization equipment will be evaluated for guidance in advanced development. Field valuation of prototype pharmacy equipment will be initiated in the combat support hospital. Testing of a field operating unit and field dental chair will be completed. Prototypes of the Military Carbon Dioxide Analysis System for detection of hidden insect infestation and ultralow volume nozzles for delivery of insecticides will be completed. Evaluation of new medical shelters will be conducted.

3. FY 1979 Planned Program : Field pharmacy equipment will be designed and fabricated based on requirements identified by the Field Pharmacy Study; i.e., communication, quality control, and drug distribution equipment. Technical, operational, and practicability evaluations of sterilizing equipment will be executed. A significant secondary effort will be modification and dissemination of information essential to the improvement of existing sterilizing equipment, techniques and procedures to insure effective sterilization capabilities in the field.

Program Element: #6.27.78.A Title: Combat Medical Materiel

DoD Mission Area: #131 - Medicine and Life Sciences Budget Activity: #1 - Technology Base

4. FY 1980 Planned Program: Feasibility studies and fabrication of experimental prototypes of proposed, new, and improved medical, and veterinary materiel will be initiated in accordance with mission objectives and fund availability. A field clinical analysis system of rugged modules designed to provide vital blood gas, electrolyte and blood chemistry data at the pre-operative and post-operative patient maintenance sites at field treatment facilities will be fabricated.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.79.A Title: Test, Measurement, and Diagnostic Equipment Technology
DoD Mission Area: #454 - Mobility and Logistics Technology Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	450	505	435	700	Continuing	Not Applicable
AH-62	Test, Measurement, and Diagnostic Technology	450	505	435	700	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The program develops new testing and diagnostic techniques and methodologies in order to simplify logistical support requirements for Army weapon systems. The present proliferation and lack of commonality within commodity oriented test, measurement, and diagnostic equipment has placed a burden on the Army in logistics and training. The proliferation of makes and models of equipment increases the requirement for personnel in the highly skilled disciplines related to testing, diagnosis, and fault isolation. The basic objectives are to provide the technology base to meet this need, to reduce incorrect diagnosis and unnecessary repairs, reduce diagnostic manpower requirements, and reduce costs of test equipment.

C. BASIS FOR FY 1979 RDTE REQUEST: Provide for the internal and contractual efforts for the continuation of the test criteria and test methodology for cost effective Built in Test for Army computers. Continue internal efforts to evaluate advanced signal analysis measurement techniques for spread spectrum, electro-optical, and pneumatic devices, and techniques to implement micro-programmable processors.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The objective of the test measurement and diagnostic equipment technology program is to develop new testing techniques and equipments which will reduce the number of different test equipments and skills required at all levels of maintenance. Major effort is directed toward the elimination of the need for most application-peculiar dedicated test equipment. New test, measurement, and diagnostic equipment will provide the Army with the capability to diagnose faults and isolate defects without tear-down. The test, measurement, and diagnostic equipment being developed will afford more efficient means of detecting equipment defects with greater accuracy, thereby offsetting the shortage of skilled manpower. The ultimate benefits to be derived from this program will be manifested in time-to-maintain and cost savings.

Program Element: #6.27.79.A Title: Test, Measurement, and Diagnostic Equipment Technology
DoD Mission Area: #154 - Mobility and Logistics Technology Budget Activity: #1 - Technology Base

F. RELATED ACTIVITIES: Program Elements 6.37.48.A (Automatic Test Equipment) and 6.47.46.A (Automatic Test Support Systems) provide the Advanced and Engineering Development, respectively for work started in this program.

G. WORK PERFORMED BY: The in-house and contract monitoring work is performed by the US Army Communications Research and Development Command, Fort Monmouth, NJ. Contractors participating in the program include: E-Systems, Falls Church, VA; Booz-Allen, Tinton Falls, NJ; Emerson Electric Company, St. Louis, MO; Dynamic Sciences International, Inc., Van Nuys, CA; Research Triangle Institute, Research Triangle Park, NC.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Successfully demonstrated a feasibility model of a modularized, microprocessor-based test system with its own software operating systems and an arbitrary waveform generator which responds to a programmable digital information generated by the systems' 16-bit microprocessor. This technique will be used in the Contact and Repair Test Equipment for use by repairmen at the lower levels of maintenance. Completed technological forecast to determine the impact of future systems' technology and design trends on projected test, measurement, and diagnostic equipment requirements for the Field Army in the 1985 to 2000 time frame. Participated in major Defense Science Board Study on the use of off-the-shelf electronic test equipment to reduce costs, shorten leadtimes, assure reliability, and simplify logistics.

2. FY 1978 Program: Complete systems' definition of the Contact and Repair Test Equipment program and finalize specifications in preparation for the Advanced Development phase. The Contact and Repair Test Equipment is a micro-processor controlled, portable automatic tester that provides stimuli, measurement, and testing capabilities. It will be a family of automatic testers used to support a variety of Army systems at the organization and direct support levels of maintenance. Develop test design methods and criteria to identify faulty large scale integrated circuits with high confidence and minimum detection time, in a field maintenance environment. Initiate Built-in-Test techniques for standard modules of high density computer systems by partitioning Built-in-Test into functional cells. These functional cells will be implemented along with new microcircuit technologies. Contractual efforts on a Test Program Sets cost study, and analysis and conceptualization in the areas of Build-in-Test will be completed.

3. FY 1979 Planned Program: For computer technology Built-in-Test: Continue to develop and demonstrate the feasibility of providing Built-in-Test for microcomputers/microprocessors in computer system applications. Techniques, hardware, and software will be defined and an analysis will be conducted to determine their relative effectiveness. A generalized concept of applying Built-in-Test to computer technology will be developed. For Built-in-Test Figure of Merit: Continue to develop methodology modeling techniques for assessing the quality of built-in-test designs for specific applications. This effort will define the various elements which comprise a Figure of Merit and will address the techniques for evaluating the fault detection capability of the Built-in-Test design. The decrease in FY 1979 funds is due to decreased contractual effort.

Program Element: #6.27.79.A Title: Test, Measurement, and Diagnostic Equipment Technology
DoD Mission Area: #154 - Mobility and Logistics Technology Budget Activity: #1 - Technology Base

4. FY 1980 Planned Program: The program to develop Computer Technology Built-in-Test will be completed. New efforts will be initiated to study and analyze advanced signal analysis and measurement techniques, and to develop algorithms for their implementation. Additional work will be conducted on microprogramable processors to determine the applicability of establishing designs for microchips or modules to directly execute key verbs of higher order level languages.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.27.80.A

Title: Medical Systems in Chemical Defense

DoD Mission Area: # 135 - Chemical Biological Warfare Technology Base

Budget Activity: # 1 - Technology Base

A. RESOURCES (PROJECT LISTING) ($ in thousands):

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	0	1800	3600	Continuing	Not Applicable
A843	Medical Systems in Chemical Defense	0	0	1800	3600	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: In response to the threat of chemical agents, program is directed toward the development of (1) medical systems for prevention and therapy of combined chemical warfare conventional injuries, and (2) a rapid casualty evaluation system. The threat of nuclear weapons requires development of means for treatment or prophylaxis against the effects of ionizing radiation.

C. BASIS FOR FY 1979 RDTE REQUEST: The protection or rapid treatment of military personnel exposed to an environment in which combined chemical/radiation and conventional injuries may be sustained requires the development of medical systems to cope with these contingencies. This new program is designed to address these problems.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The program to be initiated in FY 79 has as its objectives to minimize troop vulnerability by providing means for collective prevention and collective therapy of multiple agents with a compound effort and to develop medical systems to employ these means to protect, treat, and to evaluate casualties resulting from exposure to the broad range of chemical warfare agents at each echelon of medical treatment. This program is essential to minimize chemical casualties and to return soldiers to duty as far forward and as fast as possible, thus reducing drain on combat resources. Development will also reduce combat service support presently required for handling such casualties. Also in FY 79, a small program will be initiated with the objective of reducing radiation morbidity.

F. RELATED ACTIVITIES: Work under program element/project 6.27.34.A/H26, Medical Defense Against Chemical Agents, which is also responding to the threat of chemical warfare, focuses on individual rather than collective prevention and therapy. Studies performed under this project are closely coordinated with those being performed under program element/project 6.27.80.A/A843, Medical Systems in Chemical Defense. No other research is conducted on medical defense against nuclear radiation. The ionizing radiation program plans have been coordinated with the Deputy Director of the Armed Forces Radiobiology Research Institute.

Program Element: #6.27.80.A
DoD Mission Area: #135 - Chemical Biological Warfare Technology Base

Title: Medical Systems in Chemical Defense
Budget Activity: #1 - Technology Base

G. WORK PERFORMED BY: In-house work is performed at the Walter Reed Army Institute of Research, Washington, DC.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Not Applicable.

2. FY 1978 Program: Not Applicable.

3. FY 1979 Planned Program: Develop a casualty evaluation system that will allow rapid triage with minimum personnel resources. Perform preclinical testing of dimercaprol ophthalmic ointment formulation for use in mustard/lewisite treatment. Investigate systems for medical treatment of casualties that have a combined chemical and conventional injury. Evaluate presently available collection protection filter systems in various field medical treatment facilities and provide recommendations to the US Army Health Services Command. Evaluate state-of-the-art in prevention of chemical casualties. Develop research strategy. Focus ionizing radiation research on recent state-of-the-art advances in drug formulation and development which indicate the potential for antiradiation chemoprophylaxis. Specific efforts will include the reformulation of promising drugs and conduct of feasibility studies.

4. FY 1980 Planned Program: Advance casualty evaluation system and dimercaprol ophthalmic ointment. Continue combined injury studies, with addition of different chemical agents. Develop research strategy (1) to design a respiratory resuscitation system for large numbers of casualties and (2) to prevent chemical casualties, with emphasis on combined agents. Initiate evaluation of protective creams and ointments for feasibility as skin protection against chemical agents. The FY 79 ionizing radiation efforts will permit simulation to determine potential benefits for use as a radiation protective compound in troops exposed to varying levels of radiation.

5. Program to Completion: This is a continuing program.

FY 1979 RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: 64.27.01.A
DoD Mission Area: 415 Military Engineering Technology Base

Title: Military Energy Technology
Budget Activity: 01 -Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL PROGRAM ELEMENT	0	0	2280	2090	Continuing	Not Applicable
AT45-T1	Energy Conservation	0	0	985	1085	Continuing	Not Applicable
AT45-T2	Energy Management Systems	0	0	935	680	Continuing	Not Applicable
AT45-T3	Alternate Energy Sources	0	0	360	345	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element is oriented to facility energy systems research to provide the technology necessary to achieve the President's energy goals to reduce energy consumption in existing Federal facilities by 25% and in new facilities by 40% by 1985. The program focus is on energy conservation measures, alternative energy sources, and management of energy resources to minimize the effect of energy shortages and high costs on the military facilities and the Army mission.

C. BASIS FOR FY 1979 RDT&E REQUEST: Inexpensive, easily used techniques and procedures will be developed to analyze facility energy consumption and to evaluate energy conservation alternatives. These tools are considered essential for (1) rational formulation of energy goals, (2) analysis and evaluation of alternative strategies in the Army's energy conservation investment program and (3) establishing priorities for retrofits and proposed new construction. Research in alternative energy sources will be directed to solar energy applications and evaluation of coal technology as primary energy sources for military facilities. Major objectives include the establishment of energy utilization standards related to the building functions; the development of criteria for energy saving ventilation systems; performance evaluation and acceptance test criteria for solar heat pump system, criteria for cost effective conversion to coal, and development of criteria and specifications for automated energy control systems. Increased funding should allow this important R&D program to support facility energy conservation aspects of the Military Construction, Army and Operations and Maintenance, Army appropriations. Meeting the President's challenging energy goals requires an aggressive R&D effort.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: 6.27.81.A
DoD Mission Area: 4153 Military Engineering Technology Base

Title: Military Energy Technology
Budget Activity: 1 -Technology Base

E. DETAILED BACKGROUND AND DESCRIPTION: This program addresses the requirement to reduce energy consumption, to minimize the impact on Army operations of the increasing costs of fuel and the decreasing availability of petroleum products and natural gas for use in Army installations. The program thrust is to evaluate technology being developed by the Department of Energy (DOE) and the civilian sector, adapt those applicable to the Army through performance and procurement specifications and to develop analytical methods and management techniques so that local engineers, installation commanders and Department of the Army can assess alternatives, develop long range plans, assist in determining policy, establish requirements, set realistic goals and determine investment priorities. The level of funding is modest considering the $500 million per year Army facility energy bill that is projected to increase annually.

F. RELATED ACTIVITIES: The energy technology program was formerly a task in Program Element 6.27.31.A, Project AT41, Military Facilities Engineering Technology. This program is coordinated on an intersevice basis through the activities of the Interagency Power Group, Joint Services Civil Engineering Research and Development Coordinating Group, Tri-Service Energy Control System Specification Working Group, joint program with the Air Force and the Energy Conservation Handbook, Acceptance Testing of Power Systems, the Energy Audit Progam and the joint development of the Building Loads Analysis and System Thermodynamics (BLAST) program. Coordination with other agencies has involved a joint development of solar ponds with DOE, the validation of the BLAST program with DOE, the concept of a mixed fission product heating plant with DOE and a continuing exchange on alternate energy sources technology. Related Projects are: Project AT23 - Basic Research in Military Construction: Construction Engineering Research Laboratory (CERL), Champaign, IL. Project AT41 - Military Facilities Engineering Technology (CERL).

G. WORK PERFORMED BY: Approximately 55% of project funds are used for in-house effort at the Construction Engineering Research Laboratory with participation by the Facility Engineer Support Agency, Ft. Belvoir, VA, and the Cold Regions Research and Engineering Laboratory, Hanover, NH. Contractors will be selected at a later date.

H. PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishment: Not Applicable.

2. FY 1978 Program: Not Applicable.

3. FY 1979 Planned Program: Scheduled program highlights and accomplishments include the following: (1) complete field work on Joint Army-Air Force validation of the building thermal load analysis computer program, (2) complete development of economic analysis methodology and publish Tri-Service manual on the techniques and procurement specifications for current-technology energy control systems, (3) initiate work on feasibility analysis and development of initial performance specifications for advanced technology micro-processor base automated energy control systems, (4) evaluate new HVAC (heating, ventilating and air conditioning) technology for use in retrofit and new construction, (5) initiate development of criteria

for economic boiler conversion to coal and evaluate use of fluidized boilers and coal gassification systems for Army installations, (6) publish a report on the economic analysis and acceptance evaluation system for solar heating and cooling systems, (7) complete analysis and report on energy consumption and priorities for all Army facilities except hospitals and industrial plants, (8) field test automated operation of the Army developed installation-wide Energy Consumption, Reporting and Analysis System (ECRAS), (9) initiate study of requirements for base camp utility systems using non-tactical generators. $700 thousand was programed for energy in PE 6.27.31.AT41, Military Facilities Engineering Technology, in FY 1978. The $2200 thousand increase in funds will permit initiation of new projects in waste heat recovery, control of peak electrical demand, and improvement of boiler plant efficiency and complete HVAC (heating, ventilating and air conditioning) and coal technology work postponed from the FY 1978 planned program. The research in FY 1979 will involve 17 professional and 6 support personnel.

4. FY 1980 Planned Program: Scheduled accomplishments include the following: (1) complete validation of the building thermal load analysis computer program, publish guidelines on application and user manual, (2) complete the performance specifications for advanced technology micro-processor base automated energy control system, (3) publish performance specifications for use of new technology HVAC systems in retrofit and new construction, (4) complete the development of conversion criteria for use of coal in existing boiler systems, (5) complete the acceptance evaluation system for Army waste-derived fuel system, (6) complete validation of ECRAS, develop plan for full implementation on all Army installations, (7) establish Energy Conservation Analysis Center for the Army, (8) complete energy requirement profile for remote sites manned by the Army, (9) demonstrate feasible technology developed in Department of Energy and private sector for economical use of non-tactical generators at Army base camps. The research in FY 1980 will involve 19 professional and 7 support personnel.

5. PROGRAM TO COMPLETION: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.31.02.A
DoD Mission Area: #241 - Material and Structures

Title: Materials Scale-Up/Structures Demonstration
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1152	2382	2026	3300	Continuing	Not Applicable
D071	Materials Scale-Up/Structures Demonstration	1152	2382	2026	3300	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The work under this program is non-systems advanced development for the scale up, evaluation and demonstration of new and advanced materials for components and structures of Army weapon systems. The objective is to fully characterize scaled-up materials to the extent necessary to permit confident reliable, and cost effective use by Army weapon system design engineers. Army mission need is reflected in requirements for materials to meet increasing demands for faster, stronger, lighter, more reliable, maintainable and cheaper weapon systems. New and advanced materials, when developed, lack the levels of characterization, demonstrated reliability, maintainability and cost effectiveness necessary for confident use in new weapon systems and for product improvement of weapon systems in inventory. Lack of scaled-up demonstrated performance and demonstrated cost effectiveness of new materials causes use of outdated materials for the more demanding requirements of advanced weapon systems with resultant costly overdesign, costly and sometimes catastrophic weapon failures, and frequently unacceptable levels of cost over-runs in development. Specific mission need is reflected in unacceptable levels of reproducibility in ballistics performance of current high density penetrator munitions due to insufficient characterization of core materials; limitations of span length and stiffness of current mobile bridging structures due to need for full evaluation and characterization of advanced composites bridging materials; unacceptable levels of lethality suffered by ground combat vehicle crews and personnel due to need for full evaluation and demonstration of composite crew compartment liner materials assemblages to defeat wide angle back-face spall generated by anti-armor munitions; lack of reliability and safety in handling of current fragmenting munitions materials; and high maintenance/operations costs of advanced helicopter drive train systems components due to unavailability of demonstrated high strength/modulus - lightweight materials.

C. BASIS FOR FY 1979 RDTE REQUEST: New major programs will be initiated to scale-up, evaluate and fully demonstrate performance, realiability, maintainability, and cost effectiveness of advanced gear, bearing, drive shaft, and transmission reinforcement materials for Army helicopter drive train systems and of powdered metals compositions and alloys for cores of advanced high density penetrator munitions. Programs will be continued to evaluate and demonstrate effectiveness of scaled-up components for portable bridging, spall suppression liner materials combinations for ground combat vehicles, and of coatings and coating techniques for lining gun barrels to significantly reduce erosion problems and extend gun tube life.

Program Element: #6.31.02.A
DoD Mission Area: #241 - Material and Structures

Title: Materials Scale-Up/Structures Demonstration
Budget Activity: #2 - Advanced Technology Development

D. OTHER APPROPRATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Knowledge is being continually produced through exploratory development on new materials, new materials specifications and characterization of new materials in specimen configurations. A critical gap exists between the knowledge of these new materials in specimen configurations and the knowledge required for use of advanced new material in engineering development of Army weapon systems. This program to fill that gap, was initiated late in FY 1976 with the objective of fully characterizing advanced materials in geometric shapes used in Army systems to avoid cost overruns in engineering development; prove superiority of advanced material by competitive evaluation to avoid poor materials choices in weapon system development; fabricate scaled prototypes from advanced materials to minimize scale-up surprises; and to demonstrate cost effectiveness of advanced materials hardware to minimize cost overruns.

F. RELATED ACTIVITIES: The Air Force, Navy, other Government agencies and allied nations have analogous programs. Although similar in approach, these programs differ greatly in emphasis placed on materials advanced development for specific hardware applications. Coordination within the Department of Defense is achieved through biennial update of the Materials Technology Coordinating Paper and meetings of the Office of the Deputy Under Secretary for Defense Research and Engineering's ad hoc Services Materials Laboratories Council. Coordination with the non-military federal agencies is effected through participation in activities of the National Materials Advisory Board of the National Academy of Sciences -- National Academy of Engineering, and the Federal Council on Science and Technology - Committee on Materials. International coordination is effected through participation in the Technical Cooperation Program with Australia, Canada, New Zealand, and the United Kingdom and the Structures and Materials Panel of the Advisory Group for Aerospace Research and Development of the North Atlantic Treaty Organization.

G. WORK PERFORMED BY: In FY 1979, it is planned to accomplish approximately 50 percent of the work in-house at the US Army Materials and Mechanics Research Center, Watertown, MA; US Army Mobility Research and Development Command, Fort Belvoir, VA, and Army Armament Research and Development Command, Dover, NJ. Typical contractors are GTE/Sylvania, Towanda, PA; Lawrence Radiation Laboratory, Livermore, CA; Fiber Materials, Inc., Biddeford, MA; and Boeing Aircraft, Philadelphia, PA.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Structural foams, that are lightweight, stress free and less costly than metals, provide insulative and damping qualities and exhibit high stiffness and strength-to-weight rations, were scaled-up as ammunition pallets, track shoe components and for the pointing and stabilization element of the mini-Remotely Piloted Vehicle. Commercial ammunition pallets and prototype track shoes were evaluated. As a result of Army development of polyphosphazene fluoroelastomers, work was conducted to fabricate and evaluate gaskets, obturator pads and coated fabric for shelters. Oriented and poled polyvinylidene fluoride films were scaled-up and evaluated for sensors. Prototype microphones, strain gauges and a pulse measurement device were fabricated using these films as sensors. Work to design and fabricate refractory coated gun liners for alleviating barrel erosion problems resulted in the successful plating of 105mm M68 barrels. Work to upgrade erosion resistance o gas turbine compressor components by the application of a nickle carbonitride coating was completed. Noise and vibration of the CH-47 helicopter's lower transmission housing was reduced by bonding scaled-up doubler plates to selected locations on the housing.

Program Element: 6.31.02.A
DoD Mission Area: 7241 - Material and Structures

Title: Materials Scale-Up/Structures Demonstration
Budget Activity: 03 - Advanced Technology Development

2. FY 1978 Program: Existing high density penetrator materials are deficient in reproducibility and are costly. Specifications are being determined for core materials composition and for processing and fabricating procedures in the scaled-up state. Current portable bridging structures have span length and stiffness limitations imposed by the load capacity of the transport/retrieval vehicle. Work is being carried out to scale-up and stiffen reinforced plastic structures thereby increasing span length without increasing weight. Scaled-up bridge members and attachment components will be designed and fabricated by the pultrusion method. Severe behind-the-armor effects within combat vehicles caused by kinetic energy and other projectiles generate increased casualties and damage to critical components. Scaled-up composite spall suppression liners are being fabricated and evaluated. Advanced materials will be scaled-up as components to reduce wear/vibration in helicopter drive systems.

3. FY 1979 Planned Program: The program initiated in FY 1978 will be continued with major increases of effort to complete the work on spall suppression liners and advance the work on scaled-up military bridging components. Scale-up/evaluation of materials for high density penetrators for 726, 735, and 774 type projectiles will be completed. Work will continue on scale-up of advanced materials for the helicopter drive system of the CH-47C and BLACKHAWK. The objective of reduced wear/vibration and reduced time between overhaul of drive systems is expected to generate life time cost reductions of the order of 42 percent.

4. FY 1980 Planned Program: Work will continue on advanced materials scale-up for helicopter drive systems and military bridging components. A major scale-up program will be initiated in innovative approaches, including appliques, of armor for demonstration and evaluation to reduce the vulnerability of current armored vehicles to the high density penetrator munitions. Fragmenting munitions materials to enhance handling and launch reliability and safety will be scaled up and evaluated. Advanced composite materials will be scaled-up as anti-blast track components for Army tanks. Erosion resistant linings and coatings will be scaled-up for large caliber gun tubes.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.01.A
DoD Mission Area: #233 - Aircraft Propulsion Technology

Title: Aircraft Power Plants and Propulsion
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	To al Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3633	3067	7000	10905	Continuing	Not Applicable
D872	Propulsion Components	859	162	0	1290	Continuing	Not Applicable
D447	Demonstrator Engines	2774	2905	7000	9615	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The program objective is to demonstrate the integration and performance potential of advanced turbomachinery components and of drive train technology through tests of engines and transmissions. This advanced engine and transmission technology is then available for use in advanced airmobility systems and provides for reductions in fuel consumption, weight, maintenance requirements, vulnerable area and production costs.

C. BASIS FOR FY 1979 RDTE REQUEST: Contracts were awarded in February 1977 for the development, fabrication, and testing of two 800 shaft horsepower (SHP) Advanced Technology Demonstrator Engine (ATDE) designs. These contracts represent virtually all of the program funding.

D. OTHER APPROPRIATION FUNDS: None

E. DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to demonstrate the integration and potential of advanced turbomachinery components and drive train technology through tests of engines and transmissions. The program provides for design, fabrication, and testing of advanced propulsion systems. In recent years the need for improvements in technology has become more pronounced, not only in the areas of vehicle performance, but also in areas of cost, reliability, maintainability, safety and survivability. Advanced component technology from Army exploratory development and other Government and company-sponsored programs will be applied to advanced gas generators, engines, and drive trains in demonstration and validation tests. Primary emphasis will be placed on those areas that will benefit near-term aircraft development programs. Complete engine subsystems are integrated and tested under the Advanced Technology Demonstrator Engine (ATDE) program. The Helicopter Advanced Drive Train (HADT) program will provide the systems approach for a multi-disciplinary effort and place drive train technology on a par with the many advances made in aircraft turbine engines.

Program Element: #6.32.01.A
DoD Mission Area: #233 - Aircraft Propulsion Technology

Title: Aircraft Power Plants and Propulsion
Budget Activity: #2 - Advanced Technology Development

F. RELATED ACTIVITIES: Mutual exchanges of information occur with the United States Air Force, the United States Navy, and National Aeronautics and Space Administration. Agencies are advised of program progress by semi-annual meetings, a Tri-Service Aircraft Propulsion Technology Coordinating Paper, an informal Tri-Service Coordination Group, and visits to industry. Related Program Elements are 6.11.02, Air Mobility; 6.22.09.A, Aeronautical Technology; and 6.42.06, Utility Tactical Transport Aircraft System (T700 Engine Project).

G. WORK PERFORMED BY: Detroit Diesel Allison Division, General Motors Corporation, Indianapolis, IN; and AVCO Lycoming Engine Group, Stratford, CT. The program is the responsibility of the Applied Technology Laboratory, US Army Research and Technology Laboratories (USARADCOM), Fort Eustis, VA.

H. PROGRAM [illegible] AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Two successful efforts that have been completed were the 1500 shaft horsepower (SHP) Demonstrator Engine program and the Small Turbine Advanced Gas Generator (STAGG) program. The 1500 SHP Demonstrator Engine program identified the capabilities and limitations of an engine in that size class and has since transitioned through full engineering development as the T700 engine which is the power plant for the Army's UH-60A BLACK HAWK helicopter and AH-64 Advanced Attack Helicopter (AAH). During 1977, the Navy selected a derivative of the T700 engine for use in the Light Airborne Multi-Purpose System (LAMPS) MK III (SH-60B) helicopter. The successful STAGG program validated significant engine performance improvements in the critical gas generator section. Technology validated under STAGG has been integrated into Air Force secondary power systems, commercial helicopters, and ongoing Army helicopter development programs. In reviewing the Army's future propulsion needs it has been determined that the greatest improvement in future aircraft systems can be realized through technology verification in an engine of approximately 800 SHP. Detailed accomplishments in the 800 SHP Advanced Technology Demonstrator Engine (ATDE) program are covered in the Congressional Descriptive Summary for project D447, Demonstrator Engines, which follows. Also under this program element, several new and/or unique approaches to helicopter transmission design have been or are being validated through experimental hardware testing. Some of the designs and approaches which are now incorporated in production and/or developmental helicopters are: (1) use of ZE41 magnesium as a transmission housing material in civil applications and in the Army's UH-60A BLACK HAWK helicopter, AH-64 Advanced Attack Helicopter (AAH), CH-47D helicopter, the Navy's SH-60B helicopter, and the Heavy Lift Helicopter Advanced Technology Components program; (2) high speed spiral bevel gears in the UH-60A and SH-60B helicopters; and (3) cylindrical roller bearing in the UH-60A and SH-60B helicopters. During FY 1977 the Advanced Transmission Component program resulted in: (1) refinement of welding techniques to be used in fabrication of a stainless steel transmission housing; (2) shaping of a double-helical gear from a single piece of high hot-hardness gear steel on a new type shaper which gives the accuracy and finish of the heat-generating gear grinders; and (3) demonstration of the efficacy of a high hot-hardness gear steel as an integral inner race for a roller bearing, obtaining a material life factor equal to the best CEVM (consumable electrode vacuum melted) M50 steel for bearings.

Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsion
DoD Mission Area: #233 - Aircraft Propulsion Technology Budget Activity: #2 - Advanced Technology Development

2. FY 1978 Program: Continue the 800 shaft horsepower (SHP) Advanced Technology Demonstrator Engine (ATDE) program with the two selected contractors, AVCO Lycoming and Detroit Diesel Allison (DDA). Program goals are to demonstrate significant improvements in engine performance (reduction of specific fuel consumption by 20 percent and increase in specific horsepower of 25-35 percent) with improvements in reliability, maintainability, and survivability characteristics as compared to current engines in this class, while offering potential for a substantial reduction in production cost. Detailed plans for the 800 SHP ATDE program and other engine related new starts for each year are described in the Congressional Descriptive Summary for project D447, Demonstrator Engines. Continue the Advanced Transmission Component program designed to acquire the technology for 20 percent weight and cost reductions, 100 percent increase in life, and improvements in vulnerability and survivability of critical components intended to enter engineering development for an advanced helicopter transmisssion in the 1980's.

3. FY 1979 Planned Program: Each 800 SHP Advanced Technology Demonstrator Engine contractor will complete all detail design analysis, hardware fabrication and component rig testing. The large increase in funding is due to minimal funding in FY 1978 and the need for major hardware procurement and extensive testing in FY 1979 in the ATDE program.

4. FY 1980 Planned Program: Each 800 horsepower ATDE contractor will complete development testing of the engine and initiate the final demonstration testing. The Advanced Transmission Component program will continue with integration of components proved successful in exploratory development. A program to demonstrate the use of a spring-type, advanced, overrunning clutch in a current aircraft drive system will be initiated. This clutch promises reduced weight and improved reliability compared to existing clutches. Design and analysis of a free-planet transmission for installation in a light or medium helicopter and efforts to validate significant reductions in transmission noise will be initiated.

5. Program to Completion: This program is continuing.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D447 Title: Demonstrator Engines
Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsion
DoD Mission Area: #233 - Aircraft Propulsion Technology Budget Activity: #2 - Advanced Technology Development

A. DETAILED BACKGROUND AND DESCRIPTION: The objective of this project is to demonstrate the integration and potential of advanced turbomachinery components through tests of gas generators and engines. The program provides for design, fabrication, and testing of advanced propulsion systems. Advanced component technology from Army exploratory development and other Government and company-sponsored programs will be applied to advanced gas generators and engines in demonstration and validation tests. Primary emphasis will be placed on those areas that will benefit near-term aircraft development programs. Complete engine subsystems are integrated and tested under the Advanced Technology Demonstrator Engine (ATDE) program.

B. RELATED ACTIVITIES: Mutual exchanges of information occur with the United States Air Force, the United States Navy, and National Aeronautics and Space Administration. Agencies are advised of program progress by semi-annual meetings, a Tri-Service Aircraft Propulsion Technology Coordinating Paper, an informal Tri-Service Coordination Group, and visits to industry. Related Program Elements are 6.11.02, Air Mobility; 6.22.09.A, Aeronautical Technology; and 6.42.06, Utility Tactical Transport Aircraft System (T700 Engine Project).

C. WORKED PERFORMED BY: Detroit Diesel Allison Division, General Motors Corporation, Indianapolis, IN; and AVCO Lycoming Engine Group, Stratford, CT. The program is the responsibility of the Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, VA.

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Two successful efforts that have been completed were the 1500 shaft horsepower (SHP) Demonstrator Engine program and the Small Turbine Advanced Gas Generator (STAGG) program. The 1500 SHP Demonstrator Engine program identified the capabilities and limitations of an engine in that size class and has since transitioned through full engineering development as the T700 engine which is the power plant for the Army's UH-60A BLACK HAWK helicopter and AH-64 Advanced Attack Helicopter (AAH). During 1977, the Navy selected a derivative of the T700 engine for the Light Airborne Multi-Purpose System (LAMPS) MK III (SH-60B) helicopter. In reviewing the Army's future propulsion needs it has been determined that the greatest improvement in future aircraft systems can be realized through technology verification in an engine of approximately 800 SHP. Progress under the 800 SHP Advanced Technology Demonstrator Engine program included awarding two contracts, effective 1 February 1977. Efforts to date include preliminary configuration design, initiation of detail design, component rig testing, and completion of mock-ups to be used as engineering design tools. The 800 horsepower ATDE will be the world's most advanced turboshaft engine in the 400 to 1000 horsepower class.

Project: #D447 Title: Demonstrator Engines
Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsion
DoD Mission Area: #233 - Aircraft Propulsion Technology Budget Activity: #2 - Advanced Technology Development

2. FY 1978 Program: Continue the 800 shaft horsepower Advanced Technology Demonstrator Engine (ATDE) program with the two selected contractors, AVCO Lycoming and Detroit Diesel Allison (DDA). Program goals are to demonstrate significant improvements in engine performance (reduction of specific fuel consumption by 20 percent and increase in specific horsepower of 25-35 percent) with improvements in reliability, maintainability, and survivability characteristics as compared to current engines in this class, while offering potential for a substantial reduction in production cost. Each contractor will complete preliminary design efforts and continue detail design analysis with the objective of providing detail drawings for hardware fabrication and procurement. Component test and evaluation will continue using ATDE configured hardware to obtain performance and mechanical integrity data. Preliminary gas generator testing was initiated in the first quarter of the year to verify initial design concepts.

3. FY 1979 Planned Program: Each 800 horsepower ATDE contractor will complete all detail design analysis and hardware fabrication. Hardware modifications will be accomplished as required. Component rig testing will be completed with the option of additional testing available if required to substantiate performance or mechanical integrity. Gas generator testing will be initiated and completed (with option for additional testing as required) using final design ATDE hardware. Full engine development testing will be initiated in mid-year with the objectives of defining baseline performance and substantiating mechanical design. Ice and snow environment tests of a T700 engine inlet particle separator will be conducted at the environmental test facility, Eglin Air Force Base, FL. The large increase in funding is due to minimal funding in FY 1978 and the need for major hardware procurement and extensive testing in FY 1979 in the ATDE program.

4. FY 1980 Planned Program: Each 800 horsepower ATDE contractor will complete development testing of the engine and initiate the final demonstration testing to include low cycle fatigue, sand and dust ingestion, performance, inlet temperature distortion, and exhaust emissions. Approximately 800 hours of engine testing and 3000 hours of component testing will be accumulated by the end of FY 1980. A maintainability teardown demonstration will be conducted during the fourth quarter of the year. Draft final reports will also be initiated. Contracts will be initiated for the development and testing in an engine environment of thermally-controlled turbine shrouds. These shrouds promise to reduce leakage, thus improving engine efficiency. Contracts will be initiated to design, fabricate, and demonstrate in a gas generator the aerodynamic performance and mechanical reliability of a cooled, radial-flow turbine. This turbine promises a significant increase in efficiency compared to existing axial-flow turbines for the smaller size engine of interest to the Army.

5. Program to Completion: This program is continuing.

Project: #D447 Title: Demonstrator Engines

Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsion

DoD Mission Area: #233 - Aircraft Propulsion Technology Budget Activity: #2 - Advanced Technology Development

6. Major Milestones:

Advanced Technology Demonstrator Engine Milestones	Fiscal Year
Complete preliminary design of both 4000 shaft horsepower engines	1978
Initiate gas generator testing	1978
Complete detail design, analysis, and hardware fabrication	1979
Complete gas generator testing	1979
Initiate test of complete engine	1979
Complete development testing and initiate demonstration testing	1980
Complete maintainability teardown test and demonstration testing	1980

7. Resources ($ in thousands):

	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Cost
RDTE,A: Funds	2774	2905	7000	9625	Continuing	Not Applicable

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.06.A Title: Aircraft Weapons
DoD Mission Area: #235 - Guns and Related Technology Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2082	1577	100	1375	Continuing	Not Applicable
DK62	Aircraft Rocket Type Weapons	602	0	0	0	Not Applicable	Not Applicable
D043	Aircraft Weapons Fire Control	1341	835	100	1375	Continuing	Not Applicable
D044	Aircraft Gun Type Weapons	139	742	0	0	Not Applicable	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports the advanced development and testing of new aircraft weaponization subsystems (excluding missiles) and provides data to support engineering development of helicopter armament.

C. BASIS FOR FY 1979 RDTE REQUEST: Equations for air-to-air capability for helibome fire control systems will be formulated and integrated into a test bed aircraft.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to continue advance development design of airborne weaponization hardware for future use in helicopters. Proven concepts from exploratory development of new or improved aircraft weaponization hardware are evaluated and directed first towards general aircraft use, and second towards specific aircraft application. The primary efforts for this program are to design, fabricate, test and evaluate breadboard and brassboard models, and prototype hardware of airborne weapons and associated equipment for use in the helicopters.

F. RELATED ACTIVITIES: Project personnel maintain close liason with other military services and with industry to avoid duplication of effort. The Army participates in the Department of Defense Tri-Service Joint Technical Coordinating Group for Munitions Development. Army personnel working within this program participate in the North Atlantic Treaty Organization Air Armament Working Party and the Air Standardization Coordinating Committee, Working Party 20. These groups and working parties provide a medium for exchange of technical information and determination for joint use and standardization of airborne weaponization items. An Army representative serves on the Air Munitions Requirements And Development committee (AMRAD), an organization within the office of the Secretary of Defense. One function of this committee is the establishment of joint service requirements and development of air munitions. Related exploratory development is conducted under Program Element 6.22.01.A, Aircraft Weapons Technology, and engineering development under program element 6.42.02.A, Aircraft Weapons.

Program Element: #6.32.06.A Title: Aircraft Weapons
DoD Mission Area: #235 - Guns and Related Technology Budget Activity: #2 - Advanced Technology Development

G. WORK PERFORMED BY: Contractors are General Electric Company, Binghamton, NY; Bell Helicopter Company, Fort Worth, TX; Rockwell International, Columbus, OH; Baird-Atomic, Boston, MA; Honeywell Inc., Minneapolis, MN; Three Additional Contractors ($190,000). In-house; US Army Aviation Research and Development Command, St. Louis, MO; US Army Armament Research and Development Command, Dover, NJ; US Army Missile Research and Development Command, Huntsville, AL; US Army Test and Evaluation Command, Aberdeen Proving Ground, MD; US Army Electronics Research and Development Command, Fort Monmouth, NJ.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Feasibility of 30mm and 40mm airburst fuzes and 30mm aluminum cased ammunition was established. Investigated the feasibility of helibornе anti-radiation missile and use of semi-active lasers for guidance of point target weapons. Hardware models of laser rangefinders and moving target indicator radars were developed. Computers for Multi-Weapons Fire Control and helmet sighting systems were developed and tested. Completed tests and evaluation of use of air launched REDEYE missile against ground targets. Evaluated specifications for external stores/suspension equipment for Army aircraft. The COBRA helicopter night fire control system incorporating low light level television on the AH-1G helicopter was fabricated and evaluated. Infrared technology was utilized for weapon sighting systems at low level and under adverse weather conditions, and test bed aircraft were used to address target engagement ranges and employment techniques. Demonstrated compatibility of a special purpose electronic processing unit to operate from television and Forward Looking Infrared (FLIR) type video formats for automatic tracking of targets with remote view sighting systems. Completed integration and testing of laser rangefinder into the improved rocket fire control and XM-65 TOW missile sight. Conducted flight evaluations of helmet mounted displays and heads-up displays. The pantograph mounted laser rangefinder was acquired and flight test completed. The stabilized mirror system for ranging and tracking was fabricated and tested. The flight evaluation of the automatic tracking processor was conducted. The high impulse test bed for the constant recoil mechanism was completed. Investigated the utilization of an airborne laser tracker with both pantograph laser and the stabilized mirror system. Completed aircraft integration of a modularized day/night sight. Flight tested closed loop Fire Control feasibility model. Integrated and flight tested a modified 30mm turret with a flight qualified hydraulic constant recoil mechanism on the multi-weapon fire control system. Fabricated breadboard model of mount for development phase of high impulse recoil attenuating hardware. Evaluated Shallow Cone Shaped Charge (SCSC) for High Energy Dual Purpose round. Final report completed for the Selected Effects Armament System (SEAS). Successfully fabricated and flight tested a mast mounted sight feasibility demonstrator.

2. FY 1978 Program: A contract will be awarded to Bell Helicopter for the design and fabrication of a non-rotating platform for a prototype mast mounted sight to be installed above the UH-58 Helicopter rotor. Based on the data obtained from medium impulse recoil tests, a detailed mathematical model of the recoil mechanism will be programmed into a computer to simulate burst firings. Data from this computer will be used to further design a recoil mechanism that will be applicable to current attack helicopters. Data from the computer will also be used to compare present recoil mechanism forces with a new mechanism forces for a new hydraulic constant recoil concept.

3. FY 1979 Planned Program: Equations for heliborne fire control systems that permit counter air capability will be formulated and integrated into the multi-weapon fire control system (MWFCS) test bed.

4. FY 1980 Planned Program: Millimeter wave radar sensor for adverse weather capability will be integrated into a fire control system. A laser designator for interface with the Internal Bearing Stabilized Sighting Unit (IBSSU) platform will be fabricated. This combination will demonstrate long range designation for terminal homing missiles. A flight demonstration model of the autocuming system will be integrated into a test bed aircraft.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.07.A
DoD Mission Area: #215 - Command and Control

Title: Aircraft Avionics Equipment
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1906	1660	1304	2375	Continuing	Not Applicable
DB96	Aircraft Navigation and Control Equipment	266	387	500	0	Not Applicable	Not Applicable
DB97	Avionics Equipment	1640	1273	804	2375	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides for technology demonstration and advanced development leading to engineering development of avionics and related ground equipment. Emphasis is on hardware which will enable around-the-clock aviation operations in a mid-intensity warfare environment.

C. BASIS FOR FY 1979 RDTE REQUEST: Operate Joint Tactical Microwave Landing System (JTMLS) lead service program office. Continue previous efforts on nap-of-the-earth (NOE) communications system. Initiate fabrication of feasibility models of airborne data transfer system. Continue integration of new subsystems into test bed aircraft system.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION:

1. Project DB96 (Aircraft Navigation and Control Equipment). The Integrated Inertial Navigation System AN/ASN-132( )(V) development program will field a system that, compared to existing hardware, will be 60 pounds lighter, less expensive (about $200,000 less per aircraft), and more reliable. The Federal Aviation Administration (FAA) manages and funds the National Microwave Landing System (NMLS) development. The Armed Services have conducted and funded supporting activities such as testing in military aircraft. The Office of the Director, Defense Research and Engineering (ODDR&E) designated the Army as Lead Service for the JTMLS, a tactical derivative of the NMLS. The Army, along with the other Services and the Office of the Under Secretary of Defense for Research and Engineering, is working with the FAA to formulate the JTMLS development program. The House Armed Services Committee, and subsequently the Armed Services Committees in joint conference, deleted FY 78 Service funding for the NMLS, expressing concern over fielding the BLACKHAWK (formerly UTTAS) without an acceptable landing system, and noting that alternative systems were available. Following this action, the Army evaluated alternatives to the JTMLS. Based on the user position which emerged during this evaluation, it was concluded that a comparable alternative system should not be fielded, and that the Army should continue to pursue the JTMLS.

Program Element: #6.32.07.A
DoD Mission Area: #215 - Command and Control

Title: Aircraft Avionics Equipment
Budget Activity: #2 - Advanced Technology Development

2. Project DB97 (Avionics Equipment). Army aviation needs are addressed in the areas of nap-of-the-earth (NOE) communications, electronic counter-countermeasures (ECCM) for aircraft radios, VHF-FM communications, all-digital aircraft system, airborne data transfer systems, and improved antennas. Technical barriers need to be overcome in order to develop equipment for tactical low level operations which will meet requirements of cost, reliability, and compatibility with the helicopter environment. Other work includes development of cockpit instrumentation tailored to flight characteristics and mission profiles of Army helicopters, improvement of the man-machine interface, and providing new sensors for detection, and avoidance of obstacles ranging from wires to terrain masses.

F. RELATED ACTIVITIES: Related programs of the other Services, the National Aeronautics and Space Administration, the Federal Aviation Administration and other organizations are followed with committees, working groups, and joint developments. The Air Force Standard Inertial Navigation System and AN/ARN-118 Tactical Air Navigation system TACAN will be used in the Army's AN/ASN-132 integrated inertial/Tactical Air Navigation system. This program element is related to Program Element 6.22.02.A (Aircraft Avionics Technology) and 6.42.01.A (Avionics Systems).

G. WORK PERFORMED BY: US Army Avionics Research and Development Activity (Project DB97) and Project Manager, Navigation and Control (Project DB96), Fort Monmouth, NJ. Contractors include: Litton Systems, Woodland Hills, CA; W.W. Gaertner Research, Stanford, CT; Bell Northern Research, Ottawa, Canada; and General Electric, Binghamton, NY.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Flight tested system for tactical hover, using already developed sensors which indicated that tactical hover may be accomplished with Lightweight Doppler Navigation System (LDNS) and that a dedicated position sensor is not required. Conducted nap-of-the-earth (NOE) communications test/evaluation program for system that operates effectively during NOE flight in an electronic counter-countermeasure (ECCM) environment. Fabricated and integrated programmable symbology generator and multifunction display into the Digital Modular Avionics Program (DIMAP). Analyzed acoustical and electrical noise data and developed specifications for audio applique unit (utilizing auto correlation noise cancelling techniques) to reduce headset noise. Developed improved microphone/headset. Developed "white filter" to filter out helicopter transmission noise. Evaluated commercial model of broad band automatic direction finding device. Investigated use of liquid crystal displays for helicopter instrumentation. Evaluated conventional flight director systems. Accomplished computer modeling of aircraft vulnerability, survivability, performance, and avionics reliability. Completed development of voice gating circuitry. Evaluated cockpit lighting techniques. Initiated investigation of state-of-the-art low airspeed sensing and display systems. Demonstrated single frequency retransmission system. Developed and installed integrated target location and navigation system for Optic IV OH-6A helicopter which provides evaluation of automatic target location, offset navigation update and night hover capability.

Program Element: #6.32.07.A
DoD Mission Area: #715 - Command and Control

Title: Aircraft Avionics Equipment
Budget Activity: #2 - Advanced Technology Development

2. FY 1978 Program: Award contract for AN/ASN-132, integrated inertial navigation system advanced development, leading to engineering development start in FY 79. It had been planned that the Federal Aviation Administration (FAA) would fund Joint Tactical Microwave Landing System (JTMLS) development with the Services jointly providing $1.2 million of FY 77 funds of hardware militarization. Now it is planned that JTMLS development will be initiated with available FAA funds. The $1.2 million of FY 77 funds which the Services had planned to provide to the FAA will be retained in the DoD. $800,000 of these funds ($400,000 Army, $200,000 Navy, $200,000 Air Force) will be used during FY 78 for operation of the JTMLS Lead Service Program Office. Initiate advanced development effort for Laser Wire Detection System using results of exploratory developments efforts on Laser Obstacle Terrain Avoidance Warning Systems (LOTAWS), and multifunction LOTAWS. Award competitive contract for airborne data transfer system.

3. FY 1979 Planned Program: The JTMLS Lead Service Program Office will continue to coordinate with the FAA on JTMLS development. Conduct technical reviews of contractor efforts on airborne data transfer system. Conduct supporting engineering analyses of the design approach and assess various software options prior to final design implementation. The test bed aircraft will be configured with an integrated nap-of-the-earth (NOE) night navigation pilotage system. Award contract for laser wire detection system.

4. FY 1980 Planned Program: Flight test airborne data transfer system. Initiate study and design effort for advanced state-of-the-art communications package. Initiate fabrication of helicopter control display unit. Continue effort on laser wire detection system, including assembly of mechanical, electrical and electro-optical subsystems. Faced with difficult missions in the night nap-of-the-earth (NOE) environment, the crew needs an integrated cockpit. An advanced avionics system including an integrated cockpit and using digital integration techniques will be configured in a representative Army aircraft. The first step in the development of this avionics system with integrated sensors, processors, controls and displays and target location and handoff capability, will be the installation of a night vision system, Doppler navigator, radar altimeter, and night navigation and pilotage display system. This system will result in increased survivability, reduced pilot workload and improved mission performance for both day and night NOE operations.

5. Program to Completion: Not applicable.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.09.A
Title: Air Mobility Support
DoD Mission Area: #244 - Mobility and Logistics Technology Demonstration
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1588	1270	672	1928	Continuing	Not Applicable
DB31	Manufacturing Technology	0	0	0	0	Continuing	Not Applicable
DB32	Ground Support Equipment	50	122	0	0	Continuing	Not Applicable
DB33	Cargo Handling Equipment	137	25	0	0	Continuing	Not Applicable
DB45	Subsystems and Components	0	0	0	100	Continuing	Not Applicable
DB66	Diagnostics and Inspection	413	250	0	428	Continuing	Not Applicable
D103	Helicopter Anti/De-icing	403	180	300	1000	Continuing	Not Applicable
D266	Airdrop Prototypes & Techniques	585	701	372	400	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports advanced development (AD) of equipment, excluding aircraft, that supports the Army Air Mobility Concept. The efforts under this program respond to documented operational needs: to provide a capability for full mission aircraft operations at night, and under varying terrain and adverse weather conditions; to provide simple methods for predicting component failure; to allow external transport of loads by helicopter under low level/terrain flying operations without restricting the aircraft performance envelope; to provide rapid means of hook-up and on- or off-loading of internal cargo; to provide systems for airdrop of personnel and equipment at low altitudes or with high accuracy at high altitudes; to provide improved aviation life support equipment and other aeronautical equipment common to more than one aircraft.

C. BASIS FOR FY 1979 RDTE REQUEST: Complete flight test evaluation of ice-protected critical subsystems. Complete prototype feasibility testing of the Airdrop Controlled Exit (ACE) system to reduce extraction time of sequentially extracted airdrop loads; Continue airdrop test on the Bundle Delivery System.

D. OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: 6.32.09.A
R&D Mission Area: F24A - Mobility and Logistics Technology Demonstration

Title: Air Mobility Support
Budget Activity: 02 - Advanced Technology Development

E. DETAILED BACKGROUND AND DESCRIPTION: The on-going program (FE) provides the necessary analysis/evaluations of conceptual prototypes to allow entry of new items of mission support equipment into engineering development (ED). Efforts under this program may also lead to direct procurement of commercially available hardware or incorporation of new/improved subsystems or components into developmental or current inventory aircraft by product improvement. The program consists of the following projects: Manufacturing Technology: While planned for initiation in FY 1978, this project has not been funded for FY 1979 and FY 1980. Ground Support Equipment (GSE): Evaluates off-the-shelf equipment or conceptual prototypes and identifies common support equipment to improve servicing and maintenance of Army aircraft in a field environment. Cargo Handling Equipment: Develops verification and demonstration of technology of new concepts and design of internal and external cargo handling system for helicopters. Aircraft Subsystems and Components: Identifies and assesses the technical and operational feasibility of new items of aviation life support equipment and other aeronautical equipment which has potential for application to more than one aircraft. Diagnostics: Develops automated equipment used for condition monitoring and diagnosis of aircraft to reduce troubleshooting time and eliminate incorrect removals of aircraft components, thereby improving life cycle cost. Helicopter Anti/De-Icing: Analyzes helicopter adverse weather capability and development of anti/de-icing systems for rotor blades and other critical components. Airdrop Prototypes and Techniques: Develops selected methods of delivery of cargo and personnel by Army and Air Force aircraft to include a high level container delivery system and air delivery of land mines. Generic efforts are also included in mechanical and textile prototype development of parachutes, air items, energy dissipators, rigging devices, extraction devices, and landing systems. Systems are designed to reduce airlift aircraft vulnerability to enemy air defenses and improve operational capability for airborne assault, clandestine and special operations and airdrop resupply for all Services.

F. RELATED ACTIVITIES: Program Element (PE) 6.22.09.A, Aeronautical Technology; PE 6.22.10.A, Airdrop Technology; PE 6.42.04.A, Air Mobility Support Equipment; Helicopter Anti/De-icing efforts are coordinated with the National Aeronautics and Space Administration (NASA), the Federal Aviation Administration (FAA), the Air Force, and the Navy. Also, information exchange agreements exist between America, Britain, Canada and Australia (ABCA) and France. Joint Air Movements Board, North Atlantic Treaty Organization (NATO) Military Air Standardization (MAS) Air Transport Working Party, Joint Technical Coordinating Group for Airdrop and Transportability Agents Board are related activities for airdrop.

G. WORK PERFORMED BY: Lockheed - California Company, Burbank, CA; US Army Aviation Research and Development Command (AVRADCOM), St. Louis, MO; Applied Technology Laboratory of the Army Research and Technology Laboratories (AVRADCOM), Ft. Eustis, VA; SRF Industries, King of Prussia, PA; US Army Natick Research and Development Command, Natick, MA; Brooks and Perkins, Livonia, MI; and AAI Corporation, Baltimore, MD.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Completed operational tests to determine suitable equipment/techniques for rapid hot refueling/rearming attack helicopters in forward areas. Demonstrated the technical feasibility of a helicopter transported Container Lift Adapter, Helicopter (CLAH) for acquiring, transporting and delivering standard 8 x 20 foot MILVAN containers

without the aid of ground handling personnel or prerigging. Design for a lightweight, flightworthy, militarized version complete with interfacing components and subsystems has been completed. Two gondola systems for the external transport by helicopter of noncontainerized cargo were fabricated and static tested. Various cargo loads and configurations, methods of loading/unloading, and compatibility with materiel handling and cargo helicopters were demonstrated. Extensive testing of a complete diagnostic system of the UH-1 helicopter using implanted faulty components has been completed. Application of these diagnostic techniques has been investigated on development aircraft and has contributed to the design of the Fault-Detection/Location System which is to be used on the AH-64 Advanced Attack Helicopter. Flight tests of an ice-protected UH-1H helicopter were conducted under natural icing conditions and in the helicopter icing simulation spray facility in Ottawa, Canada. Continued development of the High Level Container Airdrop System (HLCADS). Initiated development of a Bundle Delivery System for delivery of accompanying parachutist equipment from Air Force aircraft. Initiated development of a two stage personnel parachute system to allow airdrop at 400 feet above ground level and air speeds of 250 knots.

2. FY 1978 Program: Initiate an evaluation of commercially available nondevelopment items for meeting the ground handling and servicing requirements of skid-equipped helicopters. Evaluate the Air Force Advanced Medium Short Take-off/Landing (STOL) Transport Aircraft to provide support for the Army and its interface with Air Transport systems. Complete flight test program of basic ice-protected UH-1H helicopter in natural and simulated test conditions including initial evaluation of critical subsystems such as weapons, gunsights and guidance optics. Initiated development of Bundle Delivery System; conducted feasibility test for design parameters for airdrop from C-130 aircraft. Awarded contract for flight vehicles for Ultra Hi Level Container Airdrop System. Designed and contracted for Airdrop Controlled Exit (ACE) hardware based on FY 1977 evaluations. Conduct Development Test (DT) I/Operational Test (OT) I on the Staged Personnel Parachute System.

3. FY 1979 Planned Program: Complete flight testing and analysis of ice-protected critical subsystems initiated in FY 1978. Conduct feasibility testing of the Bundle Delivery System from the C-130 Air Force aircraft using a prototype unloading device; procure additional unloading devices. Conduct cooperative US Army/US Air Force DT I/OT I of ACE. Program element funding was significantly reduced because the Synthetic Flight Training Simulator project was transferred to another program element.

4. FY 1980 Planned Program: Efforts will be initiated to establish concepts and demonstrate advanced technology in the areas of aviation life support equipment and helicopter lighting schemes. A total system feasibility study will be conducted to determine interface and integration aspects of aircraft with diagnostics installed. New areas of investigation will include improvements in cockpit displays for condition monitoring. Improved equipment and techniques for oil debris analysis will also be investigated. Flight test program for advanced rotor blade ice-protection systems will be initiated. An advanced development (AD) program for laboratory testing and evaluation of ice-phobic coatings for rotor blades will be initiated. Testing of the Bundle Delivery System from the C-130 aircraft will continue, and tests from the C-141 and Advanced Medium Short Take-off and Landing (AMST) Air Force aircraft will be initiated. Evaluation of the Ground Assembly Aids for post-airborne operations in locating/assembling personnel and equipment in night/adverse weather conditions will be completed.

Program Element: #6.32.09.A
DoD Mission Area: #244 - Mobility and Logistics Technology Demonstration

Title: Air Mobility Support
Budget Activity: #2 - Advanced Technology Development

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.11.A
Title: Advanced Vertical Take-off and Landing (VTOL)
DoD Mission Area: #232 - Aeronautical Vehicle Technology
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3986	1928	3352	10066	Continuing	Not Applicable
D157	Advanced Rotors/Flight Controls	3447	1578	2652	7332	Continuing	Not Applicable
DB41	Advanced Structures	539	350	700	2734	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army's advanced vertical take-off and landing (VTOL) program provides for the development and demonstration of large scale aircraft components and subsystems for advanced rotor concepts and demonstration of improvements in rotary wing aircraft flight controls. Advanced structures technology will be developed and demonstrated that provides increased survivability, improved reliability and maintainability, lower weight, and longer life.

C. BASIS FOR FY 1979 RDTE REQUEST: To complete a bearingless main rotor program, initiate a hover agility rotor program, initiate the preliminary design and hardware specifications for an advanced control technology integration vehicle (ACTIVE), complete the test program on the Advancing Blade Concept helicopter, conduct the aerodynamic technology program on the Rotor Systems Research Aircraft, and complete the daylight task evaluation on the UH-1 helicopter in-flight simulator, continue the flight program to evaluate the service life of composite structures applied to helicopters.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The Advanced VTOL program provides for the development, verification, and demonstration of technology for areas currently restricting the success of Army airmobile systems. This continuing program is formulated on the basis that advances in state-of-the-art technology will only be made if technology is validated in component or system demonstration in actual or simulated flight conditions. The program includes efforts in advanced rotors and control systems, and in the application of advanced structures. Foreign state-of-the-art trends, potential threats to the present and future materiel systems throughout the Research and Development cycle have been considered.

F. RELATED ACTIVITIES: The technology being developed and demonstrated in this program is related to Navy, Air Force, and National Aeronautics and Space Administration (NASA) programs. Coordination with these agencies and others is accomplished on a continuing basis through program reviews; exchange of data sheets and reports; The Technical Cooperation Program; NASA Research and Technology Committees; North Atlantic Treaty Organization (NATO) Standardization Agreements (STANAGs); and the Advisory Group on Aerospace Research and Development. This program is included in the tri-Service Aeronautical Vehicle and Structures Technology Coordinating Papers. Efforts under this program are related to activities under Program Elements 6.22.09.A, Aeronautical Technology; and 6.32.12.A, Tilt Rotor Research Aircraft; as well as major Army aircraft systems development.

Program Element: #6.32.11.A
DoD Mission Area: #232 - Aeronautical Vehicle Technology

Title: Advanced Vertical Take-off and Landing (VTOL)
Budget Activity: #2 - Advanced Technology Development

The Tilt Rotor Research Aircraft program and the rotor research program utilizing the Rotor Systems Research Aircraft are jointly funded by NASA and the Army and the high speed evaluation of the Advancing Blade Concept Compound Configuration is jointly funded by NASA, the Navy, and the Army. The aeroelastically comformable rotor and hover agility rotor programs are cofunded by both projects within this program while the bearingless main rotor program is cofunded with Program Element 6.22.09.A, Aeronautical Technology. Numerous programs in this program had their origin within efforts performed in Program Element 6.22.09.A.

G. WORK PERFORMED BY: This work is performed by the Research and Technology Laboratories of the US Army Aviation Research and Development Command located at Moffett Field, CA; Fort Eustis, VA; and Langley, VA. Work in related activities is also performed by the National Aeronautics and Space Administration (NASA) Ames and Langley Research Centers, located at Moffett Field, CA, and Langley, VA. The top five contractors are: Hughes Helicopters, Culver City, CA; Sikorsky Aircraft, Stratford, CT; Boeing Verrol Company, Philadelphia, PA; Kaman Aerospace Corporation, Bloomfield, CT; and Bell Helicopter Textron, Fort Worth, TX. Much of the contract work for FY 1979 is competitive and the contractors are to be determined. The total anticipated contract dollar value for FY 1979 is $2141 thousand.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: A Bearingless Main Rotor (BMR) flight evaluation program progressed through the design and analysis phases to completion of Froude scale wind tunnel tests of the BMR/BO-105 helicopter. Nonrotating natural frequency bench tests, a static strain survey, and deflection tests were conducted on full scale flexure hardware. A High Energy Rotor (HER) was flight tested to demonstrate the potential to eliminate the "deadman's" curve for autorotation. A fan-in-fin anti-torque and directional control system was evaluated in flight test. A hydrofluidic stability augmentation system for light helicopters was developed and tested on the OH-58 helicopter. Initial development of a UH-1H helicopter in-flight simulator was completed as were studies for development of a similar system for the XV-15 Tilt Rotor Research Analysis. Program planning for development of a High Survivability Flight Control System was accomplished. The XH-59A Advancing Blade Concept (ABC) aircraft was tested as a pure helicopter up to speeds of 160 knots indicated airspeed during a 67-hour flight test program. Flight test data were reduced and analyzed. Under a joint Army/Navy/NASA program, the XH-59A is being modified to add two J-60 turbojet engines for high speed flight testing. Planning for a Second Generation Comprehensive Helicopter Analysis System was completed and three preliminary design contracts are underway. Various elements of innovative composite hardware such as a multitubular spar main rotor blade for the AH-1G helicopter and a composite landing gear were designed, built and tested. Flight loads instrumentation and landing gear energy redistribution systems were developed.

2. FY 1978 Program: Component, ground and whirl tower testing of the final design of the BMR will be conducted. A BO-105 helicopter will be modified and instrumented. A 25 hour flight test program will be conducted to determine loads, rotor stability, and handling qualities, and flight test data analysis will be initiated. Funding will be provided for operational support of the Rotor Systems Research Aircraft (RSRA), including contract support, acquisition of spares, acquisition of automatic test equipment for routine maintenance, and in-house personnel support. Flight programs in Aerodynamics Technology, Flight Response Technology and Vibration Technology using the RSRA aircraft with the delivered S-61 rotors will be initiated. Baseline noise data on the RSRA S-61 rotor will be obtained using the In-Flight Far-Field Impulsive Noise Measurement Concept. A set of helicopter configurations

will be derived to systematically investigate individual basic handling qualities characteristics such as speed stability or cross-coupling limits using the UH-1H helicopter in-flight simulator. The evaluation of these configurations in daylight terrain flight tasks will be initiated. A competition to select a contractor to develop an Advanced Control Technology Integration Vehicle will be initiated. Modification of the XH-59A Advanced Balde Concept (ABC) aircraft and a flight test of the high speed configuration will be completed. Development of the Second Generation Comprehensive Helicopter Analysis System will be transferred to Program Element 6.22.09.A, Aeronautical Technology. Spacewound tailcones and a graphite tailcone for the OH-58 helicopter will be built and tested to provide data on composition fuselage structures.

3. FY 1979 Planned Program: The Bearingless Main Rotor (BMR) program will be completed. Flight-test data analysis and a report on performance and reliability of the BMR system will be completed. An evaluation of the capability to predict structural and aeroelastic response, loads, rotor stability, handling qualities and performance characteristics of the BMR will be made. As a follow-on to the High Energy Rotor program, a program to design, fabricate and test a Hover Agility Rotor (HAR) will be initiated, taking advantage of new composite materials. Rotor blade design will be optimized for inertia to provide improved safety, controllability, and agility to nap-of-the-earth flight; improved autorotation capability; and improved helicopter stability. Support of RSRA operations will be continued. An Aerodynamics Technology program consisting of approximately 95 flight hours on the RSRA will be completed. Flight testing on the Vibration Technology program on the RSRA will continue, and testing in the Flight Response Technology program will be started on both conventional and compound helicopter configurations. Development of an advanced rotor for testing on the RSRA will be initiated. Evaluations of handling qualities configurations on the UH-1H helicopter in-flight simulator for daylight tasks will be completed. Incorporation of visual aids in the simulation for extending the evaluation to simulated night and poor visibility conditions will be started. Preliminary design of an Advanced Control Technology Integration Vehicle (ACTIVE) will be accomplished. Specifications for electronic and actuator hardware for the system will be generated. The flight test program on the ABC high speed configuration will be completed and a final report will be published. The composite flight service evaluation program will continue. The funding increase from FY 1978 to FY 1979 will permit the initiation of the HAR project and the preliminary design of the ACTIVE.

4. FY 1980 Planned Program: Analysis and design of the Hover Agility Rotor will be completed and rotor fabrication and modification and instrumentation of a test aircraft will be initiated. Planning and contractor selection for an Aeroelastically Conformable Rotor will be accomplished and design and analysis initiated. RSRA operations support will continue. A Vibration Technology Program and a Flight Response Technology Program on the RSRA will be completed. A program to test an Advanced Attack Helicopter (AAH) or Utility Tactical Transport Aircraft System (UTTAS) rotor on the RSRA will be initiated. Design and fabrication of an advanced rotor for RSRA testing will be completed. A research rotor configuration with advanced rotor blade geometry for improved performance and acoustic characteristics will be selected for test on the AH-1G research helicopter. UH-1H helicopter in-flight simulator experiments and joint Army/National Aeronautics and Space Administration advanced controls research will continue. Contractors to supply Advanced Control Technology Integration Vehicle hardware will be selected and fabrication initiated. Design of aircraft modifications required for the system will be initiated. Evaluation of the application of advanced composite structures to helicopters will continue.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.12.A Title: Tilt Rotor Research Aircraft
DoD Mission Area: # 232 - Aeronautical Vehicle Technology Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2393	2321	1250	0	0	*23471
DB74	Tilt Rotor Research Aircraft	2393	2321	1250	0	0	*23471

* Like amount provided by National Aeronautics and Space Administration (NASA).

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This joint Army/NASA program will demonstrate the tilt rotor concept through the construction and flight testing of the XV-15 Tilt Rotor Research Aircraft. The objective is to verify that tilt rotor technology is adequate to allow development of an operational tilt rotor aircraft. The tilt-rotor concept promises increased capabilities in reconnaissance, attack, troop transport, medical evacuation, and other Army aircraft roles. This program will investigate the suitability of tilt rotor aircraft for Army missions and aid in identifying the most promising missions toward which further development of the concept may be directed.

C. BASIS FOR FY 1979 RDTE REQUEST: To provide for the basic proof of concept flight testing by the government and the military mission suitability tests which will follow based on the results of the proof-of-concept flight testing.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The tilt rotor aircraft combines the hover efficiency and maneuverability of the helicopter with the performance and productivity of a fixed wing turboprop aircraft to meet anticipated future Army air mobility and civil aviation requirements. The program is considered essential in the evolution of a prototype tilt rotor aircraft, making possible research well beyond the "demonstration of feasibility". The research aircraft will be used for investigations throughout the tilt rotor flight envelop of aerodynamics, structural and environmental characteristics, military mission compatibility, aircraft handling qualities, Vertical/Short Take-Off and Landing (V/STOL) characteristics, and near terminal operational procedures. In addition, completion of the proof-of-concept flight testing will provide a proven Vertical Take-Off and Landing (VTOL) aircraft with a wide transition corridor for general research and development of VTOL terminal operations and traffic control, including evaluation of automatic guidance systems, and handling qualities research.

Program Element: #6.32.12.A Title: Tilt Rotor Research Aircraft
DoD Mission Area: #232 - Aeronautical Vehicle Technology Budget Activity: #2 - Advanced Technology Development

F. RELATED ACTIVITIES: The Department of the Army and the National Aeronautics and Space Administration (NASA) initiated a joint research program to develop the technology for tilt rotor vehicles. In view of the need for technology and operational data to support development of civil and military vehicles with Vertical Take-Off and Landing (VTOL) capability, the Army and NASA have agreed by Memorandum of Agreement, that the combined objectives are best served by the conduct of a joint Army/NASA tilt rotor research aircraft program. The US Air Force, US Navy, and US Marine Corps are actively monitoring the program and participating in the periodic reviews. The Department of Transportation and the Federal Aviation Agency are monitoring agencies to the program with interest displayed in the transportation/navigation/avionics area. Related technology in exploratory development under Program Element 6.22.09.A (Aeronautical Technology) and in advanced development under Program Element 6.32.11.A (Advanced VTOL) supports the research and technology efforts in this program.

G. WORK PERFORMED BY: US Army Research and Technology Laboratories of the Aviation Research and Development Command with Headquarters at St. Louis, MO and the NASA/Ames Research Center, Moffett Field, CA; and Bell Helicopter Textron, Fort Worth, TX. Major subcontractors include: Rockwell International, Tulsa, OK; Calspan Corporation, Buffalo, NY; AVCO Lycoming, Stratford, CT; Hydraulic Research Textron, Valentia, CA; Steel Products Engineering Company Division, Kelsey-Hayes, Springfield, OH; and Rockwell International, Columbus, OH.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Research and testing of aeroelastically scaled rotors and of a twenty-five foot flightworthy rotor in the Ames 40 X 80 foot wind tunnel were completed. Success of these tests led the Army and NASA to the next logical step, which was flight demonstration for "proof-of-concept". In 1972, based upon the completion of preliminary design studies, a Request for Proposal was released to industry for Phase I of the program which included detail analysis, refined preliminary design, and program planning for the follow-on Phase II program. Industry responses to the Request for Proposal were evaluated and Bell and Boeing-Vertol were selected to conduct the three month Phase I effort in October 1972. The proposals for Phase II were submitted in January 1973; and in April, Bell was selected by a joint Army/NASA Source Evaluation Board. The full Phase II program was approved in September 1973. The engineering design, material procurement, and tooling efforts for the design, fabrication, and test of the research aircraft continued through FY 1974. Manufacturing and assembly of components were initiated, as were component development and systems tests. By the end of FY 1974, all major subcontracts were awarded and two additional simulations for the aircraft using the Flight Simulator for Advanced Aircraft were completed. Supporting research and technology efforts during the period included preparation of full scale rotor tests in the 40 X 80 foot wind tunnel and continued analysis of the flight control system. In FY 1975, one additional simulation of the Tilt Rotor Research Aircraft XV-15 was completed on the Flight Simulator for Advanced Aircraft. The Final Design Review was completed by mid FY 1975, and 98 percent of the drawings were released during the year. The majority of the tooling was completed and detail parts fabrication was initiated for the wing, blades, hubs, nacelles, primary controls, and fuselage. Final assembly of the fuselage progressed. The Automatic Flight Control System was completed. In FY 1976 engines and fuselages for both aircraft were delivered by major subcontractors. Fabrication of detail parts was virtually completed. Qualification testing of components and assemblies was completed. Emergency egress system tests and full-scale rotor tests were 95 percent completed. By the end of FY 1977 period, final assembly of Aircraft

Number 1 was 95 percent complete and Aircraft Number 2 was 30 percent complete. Aircraft Number 1 was rolled out at the contractor's facility on 22 October 1976 and lifted off for its first hover test on 3 May 1977. Three flight hours have been completed with that aircraft. Construction of Aircraft Number 2 neared completion in FY 1977.

3. FY 1978 Program: Deliver Aircraft Number 1 to the government in the second quarter. Conduct contractor flight testing of Aircraft Number 2. Begin government proof-of-concept flight test program to assess performance, handling qualities, and structural characteristics of the XV-15 Tilt Rotor Research Aircraft. Conduct last scheduled simulation in the Ames Flight Simulator for pilot procedural training for both government and contractor project pilots prior to start of contractor flight tests.

3. FY 1979 Planned Program: Complete effort on contracts to include manual and report preparation and deliver all existing spares. Deliver Aircraft Number 2 to the government in the 1st quarter. Complete proof-of-concept flight tests. Military mission suitability flight tests will then be conducted based upon the results of the proof-of-concept and contractor flight tests. The completion of these tests will represent the completion of the proof-of-concept program. FY79 funds are less than FY78 funds due to reduced scope of contractural effort as the project nears completion.

4. FY 1980 Planned Program: Not Applicable.

5. Program to Completion: Program planned to be completed in FY 1979.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.16.A
Title: Synthetic Flight Simulators
DoD Mission Area: #244 - Mobility & Logistics Technology Demonstration
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	882	1004	400	4790	Continuing	Not Applicable
DB34	Rotorcraft Systems Integration Simulator (RSIS)	0	0	400	1200	Continuing	Not Applicable
DB35	Aviator Training Research Simulator (ATRS)	0	0	0	2900	Continuing	Not Applicable
DB39	Flight Simulator Components (FSC)	882	1004	0	690	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for the development of a versatile, high fidelity, ground based, rotary wing simulator to support Army aircraft development and system integration. Simulation uses will support conceptual design trade-offs, prototype development and flight tests and product improvement evaluations (DB34); a current training simulator will be modified to increase its flexibility and used to examine training techniques for initial entry students, transitional/refresher training and combat readiness flying (DB35); advanced flight simulation components and systems for incorporation into future flight training systems (DB39).

C. BASIS FOR FY 1979 RDTE REQUEST: Rotorcraft Systems Integration Simulator (RSIS): This was a new start in FY 1978 under DB39. FY 1979 efforts will be to continue development and integration of advanced real time math modeling simulation systems for Army rotorcraft to be used with the National Aeronautics and Space Administration (NASA) Vertical Motion Simulator (VMS) at the Ames Research Center, Moffett Field, California.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Rotorcraft Systems Integration Simulator (RSIS): The Army Scientific Advisory Panel (ASAP) Ad Hoc Working Group on Research Facility Requirements for Nap-of-the-Earth (NOE) Day/Night Visual Flight Studies recommended that the Army, who is the lead Service for helicopter R&D, place increased emphasis on research and development in helicopter flying qualities using ground based simulation. Additionally, the Science and Technology Objectives Guide - FY 1978 (STOG 1978) recommended the Army develop improved simulators for aircraft design, specifically to support efforts to improve

helicopter handling qualities that presently limit higher speeds in terrain flight, nap-of-the-earth (NOE) maneuverability, and operation at night and poor weather. The Rotorcraft Systems Integration Simulator (RSIS) will be a modification of the National Aeronautics and Space Administration (NASA) Vertical Motion Simulator by the US Army Research and Technology Laboratory, exploiting the joint Army-NASA agreement to minimize costs and to obtain technical expertise, to develop this aeronautical engineering research facility. Aviator Training Research Simulator (ATRS): The same Army Scientific Advisory Panel (ASAP) recommended that a modest increase in flexibility of an existing training simulator for research on training be supported. The Science and Technology Objectives Guide - FY 1978 (STOG 1978) recommended the Army develop improved simulators for training. The ATRS will be developed by modifying an existing UH-1 Flight Simulator (2B24) at Fort Rucker, Alabama, with a visual display and a training experiment station. This will require the development of software integration of the motion base, visual system, and helicopter flight characteristics. Training research will be guided by a joint Army/Navy/Marine Corps coordination committee. Army training research will address Initial Entry Rotary Wing Training, Transitional Refresher Training and Combat Readiness Training. Flight Simulator Components (FSC): Provides for the development of advanced flight simulation components which can be incorporated into training devices for future aviation systems or to improve the training ability of current Army simulators. Efforts address improving representation of the real world visual scenes by increasing the field of view and scene content, size of gaming areas, and increasing the inclusion of enemy interaction (tanks, tracer fire) and improvements in instructor/operating stations.

F. RELATED ACTIVITIES: Program Element 6.42.17.A, Synthetic Flight Training Systems; and 6.22.09, Aeronautical Technology.

G. WORK PERFORMED BY: The Project Manager, Training Devices, Orlando, FL; Naval Equipment Training Center, Orlando, FL; US Army Research and Technology Laboratory, Ames Research Center, Moffett Field, CA; American Airlines Simulator Engineering, American Airlines Plaza, Fort Worth, TX.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Flight Simulator Components: Wide Angle Laser Scan and 360 Degree Annular Visual Systems development were initiated. One of these two visual systems will probably be used for the AH-64 Flight and Weapons Simulator (FWS).

2. FY 1978 Program: Flight Simulator Components: Continue the advanced development of the Wide Angle Laser Scan and 360 Degree Annular Visual Systems with the AH-64 FWS decision in September 1978. Initiate Rotorcraft Systems Integration Simulator hardware development under this project.

3. FY 1979 Planned Program: Rotorcraft Systems Integration Simulator: Continue development and integration of advanced real time math modeling simulations system for Army rotorcraft.

Program Element: #6.32.16.A Title: Synthetic Flight Simulators
DoD Mission Area: #244 - Mobility & Logistics Technology Demonstration Budget Activity: #2 - Advanced Technology Development

4. FY 1980 Planned Program: Rotorcraft Systems Integration Simulator: Continue development of real time simulation systems and initiate fabrication of hardware to allow Vertical Motion Simulator (VMS) to meet Army requirements. Aviator Training Research Simulator: Initiate development on the computer, experiment station and software integration with the motion base. Flight Simulator Components: Initiate development of algorithms for computer generated imagery.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.33.06.A
DoD Mission Area: #234 - Guided Missiles and Rockets

Title: Terminal Homing Systems
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2801	0	4100	9305	Continuing	Not Applicable
DF27	Dual Mode Seeker	1360	0	0	0	Not Applicable	Not Applicable
D236	Artillery Terminal Guidance	0	0	4100	9305	Continuing	Not Applicable
D070	Long Range Precision Designator	960	0	0	0	Not Applicable	Not Applicable
D086	Terminal Guided Submissile	481	0	0	0	Not Applicable	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Provides for the development of advanced terminal homing systems for application to terminally guided munitions (missiles/rockets/projectiles) to permit the passive attack of tactical targets. This program has been structured to examine candidate technologies and to provide the mechanism whereby mature technological approaches may be expanded for application to indirect fire weapons systems. Efforts undertaken within this program are primarily directed toward the development of advanced seeker systems for current/developmental terminally guided artillery munitions without modification to the remainder of the munition. Principal effort will be the development of a passive radio-frequency (RF) seeker for eventual application to artillery delivered guided munitions.

C. BASIS FOR FY 1979 RDTE REQUEST: Fabrication of a radio-frequency (RF) seeker by each of two competitive contractors. Laboratory and captive flight tests of these seekers to determine their capability to acquire, track and home on a variety of RF emitters (air defense radars, countermortar and counterartillery radars, ground surveillance radars). Tests and analysis will also be conducted to determine the potential accuracy of these seekers and the effectiveness of the warheads of existing/developmental guided munitions given the expected accuracy. Monitor current developments of infrared (IR) seekers for missile/projectile application for the attack of surface targets.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: A need exists to enhance the capabilities of terminally guided munitions to enable passive attack (capability to home on the inherent signature of the target) of high priority targets at greater ranges. This program has been structured to examine emerging technologies and to expand the appropriate technologies for eventual

application to terminally guided, indirect fire munitions. Primary emphasis has been placed upon the development of a radio-frequency (RF) seeker with the ability to acquire, discriminate and track radio-frequency emitters with sufficient accuracies to permit a high probability of single shot target kill. The primary targets for this type of engagement are air defense radars, artillery and mortar locating radars, and ground surveillance radars. Successful development of this seeker will permit the passive attack of these targets while maintaining maximum commonality with current semi-active laser guided munitions. This development will fully utilize the results and data of previous and current related efforts - particularly those for anti-radiation missiles (ARM) and the Air Defense Suppression Missile (ADSM). A secondary effort in this program will be the adaption of passive infra-red (IR) seekers, under development for missile/rocket application, for application to cannon/gun launched guided projectiles. The projectile IR seeker development will be fully coordinated with the Navy's IR seeker development for the 5-inch and 8-inch guided projectile which will be used in the surface-to-air role.

F. RELATED ACTIVITIES: Joint Development Program for the Army's COPPERHEAD, Program Element (PE) #6.46.11, and the Navy's 5-inch, PE #6.46.08, and 8-inch, PE #6.36.12.N, semi-active laser guided projectiles.

G. WORK PERFORMED BY: In-house work is being performed by the US Army Missile Research and Development Command, Huntsville, AL and the US Army Armaments Research and Development Command, Dover, NJ. Initial contracts for the competitive development of the IR seeker were awarded to General Dynamics, Pomona, CA and Raytheon, Bedford, MA.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: A detailed examination of the maturity and capabilities of alternate terminal homing technologies was completed in December 1976. Proposals by industry for the RF seeker were solicited, received, and evaluated. Competitive contracts for the fabrication and testing of an IR seeker were awarded to Raytheon and General Dynamics. Evaluation of these IR seekers was conducted in laboratory and captive flight tests by the US Army Missile Research and Development Command. Both prototypes demonstrated the ability to search, acquire and track various infra-red emitters.

2. FY 1978 Program: Monitor the effort and accomplishments experienced in related IR and RF seeker programs/projects and coordinate Army requirements with the related developing agencies in order to maintain the potential for commonality and to consolidate data requirements.

3. FY 1979 Planned Program: Award competitive contracts to at least two contractors for the fabrication of an RF seeker for captive flight and laboratory testing. These test results will lead to a determination of potential accuracies and the adequacy of the airframe and effectiveness of the warhead of current and developmental munitions. The principal effort will be to

develop a new seeker while maintaining the maximum commonality with the remaining portion of the applicable munition (projectile/rockets). The design and performance of developmental IR seekers will be examined for potential modification and application to guided projectiles (155 millimeter, 5-inch and 8-inch). The emphasis on the IR effort will be monitoring the current development efforts for IR seekers for potential projectile application while minimizing the modfications required to the basic projectile airframe, warhead, and control section. The increase in funding from FY 78 to FY 79 represents the fabrication of competitive RF seeker hardware for captive flight and laboratory testing.

4. FY 1980 Planned Program: Initiate the fabrication of approximately 150 radio frequency (RF) seekers for application to the selected guided projectile airframe (155 millimeter, 8-inch) for detailed evaluation and testing.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.33.13.A
DoD Mission Area: #214 - Target Exploitation

Title: Missile/Rocket Components
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	6247	3677	1344	3400	Continuing	Not Applicable
D087	Missile/Rocket Components	5094	968	0	0	Continuing	Not Applicable
D142	Tri-Service Fire and Forget Active RF Seeker (TRI-FAST)	0	1162	200	0	Continuing	Not Applicable
D293	ROLAND III (Extended Range) (NATO)	0	0	300	0	Continuing	Not Applicable
D691	Advanced Munitions	1153	1547	844	3400	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for feasibility demonstratations and studies of technology advancements in various missile and rocket system components. Efforts are concentrated in the following areas: Development of technology for a 360-degree hemispheric coverage radar; determination of the storage reliability of missile and rocket components; development of a Tri-Service active radio frequency (RF) seeker (TRI-FAST); investigation of methods for obtaining increased effectiveness and other improvements in missile/rocket non-nuclear antimateriel munitions and antiarmor munitions; determination of the feasibility of an extended range ROLAND short-range air defense missile. Data from this program provides the basis for requirement documents.

C. BASIS FOR FY 1979 RDTE REQUEST: Continue antiarmor developments for use in missiles and rockets; continue participation in the TRI-FAST RF seeker program; study the feasibility of an extended range ROLAND missile.

D. OTHER APPROPRIATION FUNDS: None.

E. DETAILED BACKGROUND AND DESCRIPTION: Four projects are included in this Program Element (PE). The Missile/Rocket Components project consists of two efforts: Development of a 360-degree, hemispheric coverage radar for advanced surface-to-air missile systems and the generation of techniques and procedures to accurately predict the storage reliability potential of missile system components and associated materials. The Tri-Service Active Radio Frequency (RF) Seeker (TRI-FAST) project is concerned with the demonstration of an active radio frequency fire and forget seeker. The ROLAND study project, which is a new start in FY 1979, will study the feasibility of extending the range capability and dynamic performance of the ROLAND missile. The advanced munitions project investigates new and more complex shaped charge lethal mechanisms for defeating projected future armor and materiel targets.

Program Element: #6.33.13.A
DoD Mission Area: #214 - Target Exploitation

Title: Missile/Rocket Components
Budget Activity: #2 - Advanced Technology Development

F. RELATED ACTIVITIES: This Program Element is related to efforts conducted in PE 6.23.03.A, Missile Technology; PE 6.26.03, Armaments Technology; PE 6.26.16, Fuzes Technology; PE 6.26.17, Munitions; PE 6.33.58.N, Weaponizing (Prototype); and PE 6.43.09, ROLAND.

G. WORK PERFORMED BY: US Army Missile Research and Development Command (MIRADCOM), Huntsville, AL; US Army Armament Research and Development Command, Dover, NJ; Sperry, Gyroscope Division, Great Neck, NY; Motorola, Scottsdale, AZ.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Hemispheric Coverage Antenna (HCA): This effort was initiated in FY 1974. A cost plus fixed fee contract was awarded to Sperry Gyroscope for the design, fabrication and testing of the antenna. The design phase of the program was completed in FY 1975. Fabrication of all components has been completed and assembly of the components is in the final stage. All test fixtures at the contractor's antenna test range were completed for the performance testing of the antenna. Storage Reliability: This effort was initiated in FY 1974. A computerized storage reliability data bank was established and updated on a continuing basis. Eighteen storage reliability data summary reports and a storage reliability parts count prediction handbook were published and widely distributed within Department of Defense and industry. Published storage failure rate data were utilized to accomplish storage reliability prediction on several systems to date including the Army's REDEYE, CHAPARRAL (Fuze and Seeker) and ROLAND short range air defense missile systems, the Army's HELLFIRE missile system, the Navy's TOMAHAWK, PRAM and MARK 48 Torpedo systems and, the Air Force's cruise missile system. Accelerated testing of PATRIOT components to determine their storage reliability potential was completed and final reports published. A component storage reliability verification program on the COPPERHEAD (Cannon-Launched Guided Projectile) system parts was initiated and will be pursued until such time as storage failure rates for the devices are established. Collection and analysis of storage reliability data were pursued on a continuing basis. Real-time testing of several pools of stored component parts was accomplished (SPRINT, MINUTEMAN, Navy missile components). Lastly, a storage reliability seminar was held in May 1976 and a storage reliability workshop was conducted in May 1977. Tri-Service Active Radio Frequency (RF) Seeker (TRI-FAST): Prior to FY 1976, this was a Navy/Air Force project and was known as the Fast Acquisition, Search and Track (FAST) Program. In June 1976, a joint program under a Tri-Service memorandum of agreement was established. A contract was awarded and Tri-Service monitorship commenced. During FY 1977 the hardware design was completed, the fabrication of missile seeker hardware and test support hardware was completed, and system integration of the hardware was initiated. Advanced Munitions: Tradeoff studies were completed on an antimateriel multipurpose submuniton to fulfill the requirements of an approved letter of agreement. The broad outline of a lethal mechanism to defeat projected future armor and materiel targets was defined and efforts initiated toward resolving engineering issues associated with the application of unconventional liner materials and new explosive formulations. Producibility studies directed toward the development of techniques for fabricating unconventional shaped charge liner metals, alloys and bimetallics were completed. Loading technology studies were conducted for the development of processes for ideal and nonideal compositions including pressing and loading, explosive qualification and safety certification.

FY 1978 Program: Hemispheric Coverage Antenna (HCA). Assembly of the antenna on the contractor's antenna test range will be completed and a series of tests will be conducted to determine antenna performance characteristics such as gain, side lobe levels and pointing accuracy. A test program will be designed to transition the HCA from a low power test bed into a high power, 360 degree hemispheric radar test bed (HHTB). This program will be continued in FY 1979 as part of Program Element 63.13.01, Missile Technology. This effort will include modification of the test range and fixtures, preparation of the necessary software and integration of the Hemispheric Coverage Antenna (HCA) with an advanced production model PATRIOT transmitter. Storage Reliability: Contractor testing of COPPERHEAD (Cannon-Launched Guided Projectile) components and in-house management of the program are the principle efforts. Tri-Service Active Radio Frequency (RF) Seeker (TRI-FAST): The prime contractor, Motorola, is fabricating five seekers; two 8-inch diameter and three 5-inch diameter. Delivery of these seekers to the Tri-Service community is scheduled for second quarter FY 1978. Government testing of these seekers, including laboratory fly-over, captive flight and sled tests, is to be completed. Advanced Munitions: Fabrication and loading technologies developed in the prior years for an antiarmor warhead will be evaluated. Prototype antiarmor warhead test hardware will be designed, fabricated, and loaded. Static warhead firing tests will be conducted to assess penetration performance. Preliminary design studies will address performance effectiveness prediction, structures analysis in high performance delivery system environments, warhead and fuze design interfacing and weapon system integration.

3. FY 1979 Planned Program: TRI-FAST: The data reduction, analysis and final report based on test data gathered in FY 1978 will be completed. No follow-on Army participation in TRI-FAST currently planned. ROLAND III (Extended Range): The study will be initiated to determine the feasibility of extending the range and dynamic performance of the ROLAND missile. Advanced Munitions: Efforts will focus on weaponizing proven lethal mechanism concepts to fill medium and heavy anti-armor weapon applications such as the Advanced Heavy Antitank Missile System (AHAMS). The full scope of the AHAMS program approach for a man-portable, crew served/armored vehicle and tank fired weapon systems concepts will be addressed through munition engineering design analysis. Manufacturing techniques for forming, finishing and qualifying precision components fabricated from unconventional materials will be developed. Munitions shall be fabricated, tested and evaluated to demonstrate penetration performance and lethal effectiveness, and the capability to perform in high stress delivery system environments. Efforts will be directed toward developing new techniques to increase greatly the effectiveness of indirect fire, anti-armor munitions by improving the hit probability through target activated fuzing submunitions.

4. FY 1980 Planned Program: Advanced Munitions: Based on the results of tradeoff studies performed previously for antimateriel submunitions, one design concept will be selected for further analysis. The contractor will demonstrate the feasibility of the selected design concept. Designs will be formulated, hardware will be fabricated and tests conducted to evaluate the performance characteristics of the submunition. Work directed toward adapting the basic search and destroy armor (SADARM) type submunition to the general support rocket system (GSRS) will be undertaken. System studies will be conducted to investigate the effectiveness of SADARM and to optimize such parameters as: Number of submunitions, dispersal techniques,

size of submunition. As a result of these studies, the munition dispersal design will be developed and models fabricated for testing in next fiscal year. Investigations will be conducted in the area of lethal mechanisms, for the development of an unconfined liner for application to general support rocket system (GSRS). In addition, hardware will be fabricated and tested. The Vortex ring parachute will be redesigned for adaption to the general support rocket system/search and destroy armor (GSRS/SADARM) submunition and models fabricated for testing in next fiscal year. The sensor application for the GSRS submunition will be investigated to optimize operating parameters. Efforts will continue on the weaponization of proven lethal mechanism concepts for antiarmor applications.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Element: #6.33.14.A
DoD Mission Area: #251 - Radiation Weapons Technology

Title: High Energy Laser (HEL) Components
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	21000	13538	17292	19000	Continuing	Not Applicable
D093	High Energy Laser (HEL) Components	21000	13538	17292	19000	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program seeks expansion of the High Energy Laser (HEL) technology base, and exploration of potential use of the HEL in a weapon system for a variety of Army mission applications. The program is conducted in concert with the HEL programs of the Navy, Air Force, and the Defense Advanced Research Projects Agency (DARPA).

The Army's first priority application is

Other applications include

C. BASIS FOR FY 1979 RDTE REQUEST:

This technology is essential for a laser for the land warfare battlefield.

Program Element: PE 33.14.A
DoD Mission Area: #251 - Radiation Weapons Technology

Title: High Energy Laser (HEL) Components
Budget Activity: #2 - Advanced Technology Development

E. OTHER APPROPRIATION FUNDS: ($ in Thousands)

	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
Military Construction, Defense Agencies	0	33449	0	0	Continuing	Not Applicable

Funds are for the High Energy Laser System Test Facility (HELSTF) at White Sands Missile Range (WSMR), New Mexico, which supports the HEL programs of the Navy and Army.

F. DETAILED BACKGROUND AND DESCRIPTION: A High Energy Laser Weapon System (HELWS) has several unique generic properties:

1. Small beam divergence - A small spot of intense radiation can be precisely placed on small targets, or on a small vulnerable area of a large target.
2. Speed of light delivery -
   a. Aiming error can be sensed immediately and corrected.
   b. The target cannot evade the laser beam.
3.
4. Low fuel ("ammunition") consumption per shot - permits many shots to be stored on board.

These properties give the HELWS a high potential

HELWS development includes the following areas: (1) the laser device - the beam generator; (2) beam control - the pointer/tracker which directs the beam precisely to the aimpoint; (3) propagation - study of the atmosphere and distortion of the laser beam as it travels through the atmosphere, and compensation techniques to maximize energy delivery on target; and (4) damage effects and vulnerability.

F. RELATED ACTIVITIES: Complementary programs to expand the technology base and evaluate high energy laser potential are being conducted by the Navy (PE 6.35.78.N, Test Bed Development and Demonstration, and PE 6.37.54.N, High Energy Laser), Air Force (PE 6.36.05.F, Advanced Radiation Technology and PE 6.26.01.F, Advanced Weapons), and the Defense Advanced Research Projects Agency (DARPA) (PE 6.23.01.E, Strategic Technology). The different battle environments and system platforms for each Service require significantly different HEL technology. The Service programs are closely coordinated by the Office of the Under Secretary of Defense (Research and Engineering). A number of the work efforts in the Department of Defense HEL program are jointly funded and performed. In prior years, Army HEL development has been funded under Program Element 6.21.38.01.A (High Energy Laser Research), 6.26.03.A (High Energy Laser Research), 6.26.09.A (Project

EIGHTH CARD), 6.26.12.A (Project EIGHTH CARD), 6.27.03.A (High Energy Laser Research), 6.27.05.A (High Energy Laser Research), 6.26.21.A (Laser Technology and Applications), and 6.36.11.A (High Energy Laser Development, Advanced Laser Development, and Project EIGHTH CARD).

C. WORK PERFORMED BY: The top five contractors are: AVCO-Everett Research Laboratories, Everett, MA; TRW, Inc., Defense and Space Systems Group, Redondo Beach, CA; United Technologies Corp., Pratt & Whitney Aircraft Group, Government Products Division, West Palm Beach, FL; United Technologies Corp., United Technologies Research Center, East Hartford, CT; and Bell Aerospace Textron, Buffalo, NY. There are 16 additional contractors with an estimated total contract dollar value of $3.1 million in FY 1978. Principal Army Government organizations conducting this development program are the High Energy Laser Systems Project Office and the US Army Missile Research and Development Command (MIRADCOM), Huntsville, AL. Additional work is being accomplished at other Government facilities, including the US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA; the US Army Armament Research and Development Command, Aberdeen, MD; the US Army Electronics Research and Development Command, Fort Monmouth, NJ; the White Sands Missile Range, NM; and the Lawrence Livermore Laboratories, Livermore, CA.

II. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments:

Summary - Technologies necessary for High Energy Laser Weapons were identified and partially developed through research, subscale demonstrations, and selected scaling experiments. Systems studies established potential Army applications and advantages over alternate weapons.

Laser Device Technology - The Army is responsible, within the integrated DoD program, for the majority of the

Program Element: #6.33.14.A
DoD Mission Area: #251 - Radiation Weapons Technology

Title: High Energy Laser (HEL) Components
Budget Activity: #2 - Advanced Technology Development

Beam Control Device Technology -

Propagation/Effects/Lethality -

Systems Analysis - The feasibility of HEL systems for air defense, ground-to-ground, and air-to-ground applications was established, and several point designs. were completed.

Program Element: #6.33.14.A
DoD Mission Area: #251 - Radiation Weapons Technology

Title: High Energy Laser (HEL) Components
Budget Activity: #2 - Advanced Technology Development

Mobile Test Unit (MTU):

2. FY 1978 Program:

Summary: Several major technolgy programs will be completed and critical hardware will undergo final testing. Major emphasis will be on

Laser Device Technology - In the laser area, the technolcgies developed in FY 1976 and 1977 will be brought together into a module demonstration called Modular Army Demonstration System (MADS).

Beam Control Device Technology -

Program Element: #6.33.14.A Title: High Energy Laser (HEL) Components
DoD Mission Area: #251 - Radiation Weapons Technology Budget Activity: #2 - Advanced Technology Development

Propagation/Effects/Lethality - The major thrust of the propagation effort in FY 1978 is in three areas:

Systems Studies - System definition designs for a will continue. Feasible technical approaches will be determined for systems concepts identified as a result of an on-going comprehensive mission analysis

3. FY 1979 Planned Program:

Summary - Emphasis will continue to be on

Laser Device Technology - In the major area of emphasis.

A modest level will be maintained in the areas of component fabrication technique improvement (for cost reduction) and of development of an advanced technology base.

Beam Control Device Technology -

Propagation/Effects/Lethality - The propagation effort will continue to support the lethality verification and systems definition efforts. Also, a broader analysis will be pursued to extrapolate results of systems designs and effects/lethality data to a wide spectrum of environments and scenarios.

Systems Studies - Further detail will be developed at a moderate level for approaches

4. FY 1980 Planned Program:

Summary - The primary thrust will be on,

Laser Device Technology -

Beam Control Device Technology -

Propagation/Effects/Lethality - The primary thrust of this effort will be the evaluation of reliable laser device and beam control device capabilities in a wide range of environments and scenarios. The output of this evaluation will be used to define in detail the

System Studies - Detailed evaluation of the primary air defense and other missions will continue.

5. Program to Completion: It is anticipated that

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.02.A
DoD Mission Area: #239 - Land Mobility Technology

Title: Advanced Land Mobility System Concepts
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2917	2000	22000	11704	Continuing	Not Applicable
D118	Combat Vehicle Technology	2917	2000	2000	6800	Continuing	Not Applicable
D188	High Survivability Test Vehicle	0	0	10000	4904	27000	41904
D305	Advanced Antiarmored Vehicle	0	0	10000	0	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The purpose of this program is to develop conceptual combat vehicles and experimental test bed vehicles. These conceptual test-bed vehicles will incorporate new and advanced technology components that will enhance the ground mobility and combat effectiveness of combat vehicles. Conceptual vehicles employing advanced mobility concepts will be developed to determine feasibility. This program will alleviate many of the problems previously encountered in incorporating components representing new technology into system-oriented developmental vehicles. Continuation of this program will expand the combat vehicle technology base for exploitation by the Army. The joint program with the Marines and the Defense Advanced Research Projects Agency (DARPA) to explore lightweight combat vehicles is funded in this program.

C. BASIS FOR FY 1979 REQUEST: Complete fabrication of the High Survivability Test Vehicle-Lightweight (HSTV-L), a small, highly agile armored vehicle mounting a 75mm gun of excellent armor-piercing capabilities and a radically new approach to fire control/acquisition. This vehicle will weigh between 17-22 tons. The High Mobility/Agility test vehicle (HIMAG), a 27-45 ton variable component test bed built to examine the relationship between mobility and survivability will be extensively evaluated in field tests. These evaluations will provide the data base for future combat vehicles. An elaborate data reduction and analysis program will provide cost effectiveness values for future decisions. Test firings of the 75mm gun will occur to provide a thorough knowledge of gun limitations and capabilities. This program will be jointly funded with the DARPA and the United States Marine Corps. International cooperative efforts in combat vehicle technology will occur directly relating to the HSTV-L and other future technology base programs. Initial design work on an advanced concept for other armored fighting vehicles will also occur.

Milestones	Date
Completion of HSTV-L fabrication	August 1979
Testing of HIMAG at Fort Knox, KY	February 1978-August 1979
Testing of HSTV-L at Fort Knox, KY	September 1979-September 1980

D. OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.36.02.A
DoD Mission Area: #239 - Land Mobility Technology

Title: Advanced Land Mobility System Concepts
Budget Activity: #2 - Advanced Technology Development

E. DETAILED BACKGROUND AND DESCRIPTION: The Army has a continuing need to increase its ground combat vehicle technology base through examination of innovative concepts and unique weapons systems. While theoretical studies provide a great deal of information, it is mandatory that hardware test bed vehicles be fabricated which can be evaluated under actual field conditions. This program encompasses development and evaluation of experimental test bed vehicles incorporating the very latest technology and innovative concepts. The objective is to increase the mobility and combat effectiveness of future combat vehicles while decreasing developmental costs and time. The efforts conducted under this program will permit the exploration of revolutionary technology in test beds resulting in proven components and concepts to be incorporated in future Army combat vehicle systems. Continuous upgrading of the technology will enable the United States to maintain superiority over combat vehicles fielded by other countries. In a continuing program, concepts will be designed and fabricated to insure that chassis and weapon station components are available to meet forthcoming needs; and the effort of integrating these components into total systems will be assessed.

F. RELATED ACTIVITIES: Specific programs related to the technical areas of this program element (PE) are: PE 6.11.02.A, Project P22, Research in Vehicle Mobility, PE 6.21.05.A, Materials; 6.26.03.A, Large Caliber and Nuclear Technology; PE 6.26.06.A, Advanced Concepts Laboratory; PE 6.27.33.A, Mobility Equipment Technology; PE 6.26.18.A, Ballistics Technology; PE 6.31.02.A, Materiels Scale-Up; PE 6.32.01.A, Aircraft Power Plants, Project 477, Demonstrator Engines; PE 6.26.08.A, Tank Gun Development and Tank Ammuniton; PE 6.36.21.A, Vehicle Engine Development; and PE 6.36.25.A, Armored Cavalry Vehicle. Close relationship is maintained with other Services and Governmental agencies. Research and development information concerning Combat, Tactical and Special Purpose Vehicles is also being exchanged via data exchange agreements with allied countries. Close coordination prior to any budgetary decision is physically maintained and exchange of technical reports through the data exchange agreements is achieved. The High Survivability Test Vehicle-Lightweight (HSTV-L) is a joint program with the Marines and the Defense Advanced Research Projects Agency (DARPA).

G. WORK PERFORMED BY: Primary in-house efforts will be performed by the US Army Tank-Automotive Research and Development Command, Warren, MI. Other in-house efforts will be performed by the US Army's Armament Research and Development Command, Dover, NJ; Human Engineering Laboratory, Aberdeen, MD; Ballistics Research Laboratory, Aberdeen, MD; Army Materiel Systems Analysis Agency, Aberdeen, MD; Waterways Experimentation Station, Vicksburg, MS; and US Army Armor Center, Fort Knox, KY. Contractors involved will be: Aircraft Armaments Incorporated (AAI), Baltimore, MD; National Water Life, Kalamazoo, MI; Delco Corporation, Santa Barbara, CA; Hughes Aircraft Corporation, St. Louis, MO; Texas Instruments, Dallas, TX; BDM Corporation, Falls Church, VA; and Systems Planning Corporation (SPC), Arlington, VA.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Design study contracts for the HSTV-L were conducted and source selection for one contractor to fabricate the HSTV-L was conducted. The extended M113A1 Armored Personnel Carrier was fabricated and evaluated.

Program Element: #6.36.02.A
DoD Mission Area: #239 - Land Mobility Technology

Title: Advanced Land Mobility System Concepts
Budget Activity: #2 - Advanced Technology Development

2. FY 1978 Program: Initiate fabrication of the High Survivability Test Vehicle-Lightweight (HSTV-L). Initial concept feasibility work will begin on the next test bed vehicle to follow the HSTV-L.

3. FY 1979 Planned Program: Complete fabrication, initiate testing and evaluation of the HSTV-L. The High Mobility/Agility (HIMAG) test vehicle will continue testing and evaluation at Fort Knox, KY, and White Sands Missile Range (WSMR), NM, where the 75mm test fixture gun will be fired and evaluated. Analysis of test data provided by the HIMAG and HSTV-L vehicles will occur. Design studies and initial fabrication of the test bed vehicle to follow HSTV-L will occur. Joint efforts with the Federal Republic of Germany (FRG) will begin with exchange of test bed hardware, evaluation of the 75mm gun and joint testing. Other advanced concepts and systems will begin design and evaluation.

4. FY 1980 Planned Program: The HSTV-L and HIMAG will complete testing and evaluation. Final report on HSTV-L program will be prepared and recommendations for future light armored vehicles will be provided. The next test bed vehicle after HSTV-L will begin fabrication. Joint efforts with the FRG and other NATO countries to develop a common combat vehicle technology base will continue.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D188 — Title: High Survivability Test Vehicle
Program Element: #6.36.02.A — Title: Advanced Land Mobility System Concepts
DoD Mission Area: #239 - Land Mobility Technology — Budget Activity: #2 - Advanced Technology Development

A. DETAILED BACKGROUND AND DESCRIPTION: This program supports a joint Army, Defense Advanced Research Projects Agency (DARPA) and Marine Corps program entitled "Armored Combat Vehicle Technology Program". The purpose of this joint program is to determine payoff for high levels of mobility and agility in combat vehicles, develop the 75mm gun initiated by DARPA and examine the 75mm gun combined with small, lightweight vehicles. Test bed vehicles are being fabricated and tested under this joint program. These vehicles include the High Survivability Test Vehicle-Lightweight (HSTV-L), a 17-22 ton test bed vehicle mounting an improved 75mm gun and the High Mobility Agility (HIMAG) test vehicle, a 27-45 ton variable parameter test bed vehicle mounting a test fixture 75mm gun. The test fixture gun can be fired either with high recoil forces or low recoil forces. The HIMAG is a rolling laboratory instrumented to provide extensive data on fire control systems, human factors, vehicle suspensions and other areas. The HSTV-L is a small, lightweight vehicle employing innovative design features to increase vehicle survivability. Advanced componentry is incorporated in both vehicles which will enable future vehicles to incorporate tested components. The program will culminate in FY 1980 with a recommendation on future development of light armored combat fighting vehicles.

B. RELATED ACTIVITIES: Program elements (PEs): PE 6.21.03.A, Materials; PE 6.26.0 .A, Large Caliber and Nuclear Technology; PE 6.26.18.A, Ballistics Technology; PE 6.27.09.A, Night Visions Investigations; PE 6.27.16.A, Human Factors in Military Systems; PE 6.36.23.A, Vehicle Component Development; and PE 6.57.06.A, Material Concepts Evaluations.

C. WORK PERFORMED BY: In-house organizations participating in this program are: US Army Tank-Automotive Research and Development Command, Warren, MI; US Army Armament Research and Development Command, Dover, NJ; Waterways Experimentation Station, Vicksburg, MS; US Army Armor Center, Fort Knox, KY; Ballistic Research Laboratory, Aberdeen, MD; Marine Corps Development and Education Center, Quantico, VA; and US Army Infantry Center, Fort Benning, GA. Major contractors are: AAI Corporation, Fort Clinton, OH; Aircraft Armaments, Incorporated (AAI), Baltimore, MD; Texas Instruments, Dallas, TX; and Delco, Detroit, MI.

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Spacing Position Test Bed Vehicle was evaluated at Fort Knox, KY. Design study contracts for HSTV-L were completed. Joint program with DARPA and the US Marine Corps was established.

2. FY 1978 Program: Initiate fabrication of HSTV-L.

3. FY 1979 Planned Program: Complete fabrication of the HSTV-L. Initial testing of the HSTV-L will begin at Fort Knox, KY. Testing will be conducted on the HIMAG vehicle with 75mm gun firings at Fort Knox, KY, and White Sands Missile Range (WSMR), NM. Data analysis will be conducted on data obtained from HIMAG vehicle and gun tests. The increase in funding results from the preponderance of the fabrication of the HSTV-L being performed during FY 1979 and the conduct of field experimentation with the HIMAG vehicle.

Project: #D188 — Title: High Survivability Test Vehicle
Program Element: #6.36.02.A — Title: Advanced Land Mobility System Concept
DoD Mission Area: #239 - Land Mobility Technology — Budget Activity: #2 - Advanced Technology Development

4. FY 1980 Planned Program: Complete testing of High Survivability Test Vehicle-Lightweight (HSTV-L) and High Mobility/Agility (HIMAG) test vehicles. Data analysis will continue and the results derived will be presented in a final report on recommendations for development of light armored combat vehicles.

5. Program to Completion: Enter into development of a light armored combat vehicle if that recommendation is made at the conclusion of the FY 1980 program.

6. Major Milestones:

Milestone	Date
Contract award for HSTV-L fabrication.	November 1977
Testing of HIMAG at Fort Knox, KY, and White Sands Missile Range.	October 1978-August 1979
Complete fabrication of HSTV-L.	September 1979
Begin testing of HSTV-L.	October 1979
Complete testing of HSTV-L.	August 1980
Report completed.	October 1980

7. Resources ($ in thousands):

	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Cost
RDTE: Funds	0	0	10000	4904	27000	41904

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D305 Title: Advanced Anti-Armor Vehicle (NATO)
Program Element: #6.36.02.A Title: Advanced Land Mobility System Concepts
DoD Mission Area: #239 - Land Mobility Technology Budget Activity: #2 - Advanced Technology Development

A. DETAILED BACKGROUND AND DESCRIPTION: This program supports joint technology between the United States Army and North Atlantic Treaty Organization (NATO) members. The Federal Republic of Germany (FRG) and other NATO nations have expressed interest in technology base efforts for lightweight anti-armor vehicles and medium caliber weapons. A program involving the FRG will enable the United States to take advantage of the FRG's data base built up on future armored vehicles, their testing, and high mobility combat vehicle test beds with sophisticated fire control systems. The FRG has a sizable investment in instrumented test ranges which will be fully incorporated into joint US/FRG efforts. This joint program will encompass cooperative efforts on various aspects of the Armored Combat Vehicle Technology Program. The joint program will provide for a comparison on individual mobility versus unit mobility. This effort will determine how combat vehicles of unusual mobility and agility can be incorporated into effective combat formations. Included in this aspect of the program will be a determination of what level of armor protection is required to defeat potential enemy weapons, what pay off exists for increased survivability with reduced vehicle silhouette and increased mobility/agility, what are the distances at which engagements will be fought, and what fire control is required in highly mobile and agile combat vehicles. Recognizing that differences exist in how to meet perceived needs the program will provide a common basis for evaluating trade-offs of vehicle mobility and armor protection. Standard methods of developing test plans for combat vehicles and test evaluation will result. Cooperative efforts in vehicle design simulators which will reduce hardware costs and time in vehicle development will be pursued. The final product of the cooperative efforts will be the attainment of common conclusions as to future combat vehicle requirements.

B. RELATED ACTIVITIES: Program Elements (PE) 6.21.05.A, Materials; 6.26.01.A, Tank-Automotive Technology; 5.21.03.A, Large Caliber Technology; 6.26.18.A, Ballistics Technology; 6.27.09.A, Night Visions Investigations; 6.27.16.A, Human Factors in Military Systems; and 6.57.06.A, Materiel Concepts Evaluations. Frequent coordination conferences are held to insure coordination and avoid duplication.

C. WORK PERFORMED BY: In-house organizations participating in this program are: US Army Tank-Automotive Research and Development Command, Warren, MI; US Army Armament Research and Development Command, Dover, NJ; Waterways Experimentation Station, Vicksburg, MS; US Army Armor Center, Fort Knox, KY; Ballistic Research Laboratory, Aberdeen, MD; US Army Command Development Experimentation Center, Montery, CA; and US Marine Corps Development and Education Command, Quantico, VA.

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Not applicable.

2. FY 1978 Program: Not applicable.

Project: #D305 Title: Advanced Anti-Armor Vehicle (NATO)
Program Element: #6.36.02.A Title: Advanced Land Mobility System Concepts
DoD Mission Area: #239 - Land Mobility Technology Budget Activity: #2 - Advanced Technology Development

3. FY 1979 Planned Program: US/FRG joint tests of high mobility test beds will be conducted. FRG vehicles will be evaluated in the US in conjunction with the US high mobility vehicles. The 75mm gun with ammunition will be provided to the FRG for test and evaluation. Instrumentation used by both the US and FRG in that program will be exchanged. Extensive joint analysis of systems performance, force mix, tactics, doctrine, and computer simulation models will take place.

4. FY 1980 Planned Program: Not applicable.

5. Program to Completion: Not applicable.

6. Major Milestones:

	Date:
Program Discussions with FRG	February 1978
Negotiation of Memorandum of Understanding	March-July 1978
Program Initiation	October 1978

7. Resources ($ in thousands):

	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
RDTE,A: Funds	0	0	10000	0	0	0

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.04.A
DoD Mission Area: #218 - Advanced Weapons Effect and Nuclear Munitions

Title: Nuclear Munitions and Radiacs
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT					Continuing	Not Applicable
D089	Nuclear Burst Detection System (NBDS)						
D135	Nuclear Weapon Development Support					Continuing	Not Applicable
D153	Nuclear Effects Support Team (NEST)					Continuing	Not Applicable
D443	Nuclear Projectiles					Continuing	Not Applicable
D483	Radiological Detection and Measuring Equipment					Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army must be able to conduct both offensive and defensive nuclear operations. This requires development and acquisition of equipment that can survive in nuclear environments. Also required is the ability to locate nuclear bursts and estimate the yields and fallout producing potential, to integrate these data into battlefield information system programs and to detect radiation and fallout. Currently, the technique for locating nuclear bursts is visual. Reporting times are slow; often data from the same burst are different; and accurate estimates of yield and fallout producing potential are unlikely. This program will provide the Army with an ability to detect and locate nuclear bursts automatically, to estimate the yield and fall and potential, and to report the information in near real time to appropriate command centers. Current radiation detection equipment is very old, and is unable to measure all the necessary environments expected on the tactical nuclear battlefield. This program also provides the Army with an advanced, state-of-the-art family of radiac equipment that will detect and measure radiation and provide commanders and medical personnel with radiation histories of units and individuals. Such a capability is very important but is not available today. A requirement also exists to integrate the research and development aspects of Army nuclear weapon programs with the remaining life-cycle functions. Also required

is a method of insuring that nuclear hardening technology is appropriately applied during development of all Army systems. The Nuclear Weapon Development Support and the Nuclear Effects Support Team projects meet these two requirements. Finally, the Army must insure that advancements in the state-of-the-art in ballistics and conventional ammunition are appropriately related to the family of nuclear weapons. This program provides that capability as well. If modernized, nuclear survivable equipment is not developed the Army will have to rely on "nuclear soft" systems and if the burst detector and the radiac equipment are not developed to measure and record the radiation environments expected on the tactical nuclear battlefield--combat effectivenes will be substantially degraded.

C. BASIS FOR FY 1979 RDTE REQUEST: Advanced development will be done on cost-effective technical improvements in nuclear projectile technology such as improved rocket assist propellants. Artillery application of tactical earth penetrators will be developed. Development of a Nuclear Burst Detector will continue. Support for various Project Managers (PM) in the area of nuclear survivability will be expanded as part of the Army Nuclear Survivability Program. Improvements in the family of radiological detection and measuring equipment will be developed and preparation for transition either to further engineering development or preferably directly to production will be made. Support of Joint Department of Energy-Department of Defense (DOE-DOD) Phase 2 Nuclear Weapon Feasibility Studies will continue.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Emphasis in the advanced development (AD) of artillery projectiles will be in technology to increase range, reduce collateral damage, and improve safety, security and command and control. The increased range concepts provide substantially improved effectiveness and survivability of the nuclear delivery forces. The reduced collateral damage efforts enhance deterrence by making the nuclear forces a more credible deterrent. Artillery applications of earth penetrator technology offer the potential for cost effective stand-off atomic demolition munitions and for attack of hardened structures with reduced collateral damage. The family of radiological detection, measurement and alarm devices will be improved through application of technology developed in this PE. The objective is to apply such improvements as "large scale integration" technology to electronics in radiac equipment and to transition such improvements directly to production without further engineering development. Potential cost savings in this technology are substantial. R&D support for non-system related functions such as overall command, control and security of the stockpile will be provided by the Project Manager, Nuclear Munitions. A Nuclear Effects Support Team will provide technical support to system PM's in the area of nuclear survivability and hardening. This is a key element of the Army Nuclear Survivability Program.

F. RELATED ACTIVITIES: This program complements and is closely coordinated with DOE advanced development efforts. Exploratory development efforts in PE 6.26.03.A, Large Caliber and Nuclear Technology, are utilized. Tactical earth penetration programs under PERSHING II auspices, PE 6.33.11.A, and those being accomplished by the Defense Nuclear Agency are incorporated. There is

no duplication of efforts under the Department of the Air Force nuclear burst detection programs which are oriented more on strategic than tactical weapon detonation detection. Tri-Service radiological detection programs are coordinated and integrated.

G. WORK PERFORMED BY: US Army Armament Research and Development Command, Dover, NJ; Harry Diamond Laboratories, Adelphi, MD; US Army Materiels and Mechanics Research Center, Watertown, MA; and US Army Electronics Research and Development Command, Fort Monmouth, NJ. Principal contractors include Bendix Corporation, South Bend, IN; and Sandia Laboratories, Albuquerque, NM.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Advanced development (AD) of various artillery projectiles, atomic demolition munitions, and surface-to-surface missile adaption kits was completed in the early to mid 1970s. Most of the technology has been incorporated in appropriate engineering development programs such as the 8-inch nuclear projectile and the LANCE MOD 3 nuclear warhead section. The nuclear burst detector continued in AD in FY 1977. Techniques were developed and tested successfully to discriminate between nuclear bursts and lightning. A magnetic technique for inexpensively and accurately locating nuclear bursts was developed. Digital and "large scale integration" (LSI) technology to enable cost-effective improvements in the family of radiac instruments were developed in FY 1977. Project Manager (PM) Nuclear Munitions provided substantial effort in identifying improvements required in the nuclear weapons stockpile in FY 1977.

2. FY 1978 Programs: AD of components such as fuzing, rocket motor propellants and bonding schemes, and projectile joint technology related to 155mm nuclear projectiles will begin. Additionally, an overall effort on extended range and reduced collateral damage techniques for artillery projectiles will continue. The Nuclear Burst Detection System effort will continue at a very low level utilizing FY 1977 funds that were specifically earmarked for this purpose when budget adjustments were made in December 1976. The radiological detection and measuring equipment efforts will continue level-of-effort development of cost effective improvements to the radiac equipment.

3. FY 1979 Planned Program: Funding will be resumed for the nuclear burst detector to enable completion of AD and demonstration of feasibility. Support to PM Nuclear Munitions for nonsystem related effort will be expanded to enable additional support of the Tri-Service emergency disablement systems programs. Nuclear Effects Support Team effort will begin. This effort provides substantial support to system PMs in the area of nuclear survivability and is a key element in the Army Nuclear Survivability Program. AD work supporting the 155mm nuclear projectile will be completed. Additional effort will focus on extended range and improved safety for artillery projectiles. Level-of-effort development on cost effective improvements to radiac equipment will be continued.

4. FY 1980 Planned Program: Testing of the AD model of the nuclear burst detector and transition to full scale engineering development will be completed. Support by PM for Nuclear Munitions for nonsystem related programs and the Tri-Service Emergency

Program Element: #6.36.04.A
DoD Mission Area: #218 - Advanced Weapons Effect and Nuclear Munitions

Title: Nuclear Munitions and Radiacs
Budget Activity: #2 - Advanced Technology Development

Disablement Systems Project Officer's Group will be continued. Support to PMs will be continued in the area of nuclear survivability. Testing of extended range, reduced collateral damage concepts for artillery projectiles will be expanded. Technological development of radiac components will be continued.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.06.A
Title: Landmine Warfare
DoD Mission Area: #237 - Mines and Mine Countermeasures
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2452	1813	8690	7157	Continuing	Not Applicable
DC06	Landmine Warfare	2452	1813	4690	7157	Continuing	Not Applicable
D146	SLUMINE	0	0	4000	0	Continuing	

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Provides for advanced development of components and concepts applicable to landmine warfare and the family of scatterable mines (FASCAM). Mines continue to provide a formidable obstacle to assist in overcoming the massive tank threat posed by the Warsaw Pact. Mines are required to fortify natural obstacles such as defiles, rivers, and built-up areas in order to delay, canalize, and interdict attacking forces and enhance the performance of direct and indirect fire weapons. Component efforts include improved sensors, fuzes, target discrimination logic and anticountermeasure devices to improve the overall effectiveness of mines and make minefields more difficult to traverse. New concepts include controllable minefields for greater battlefield mobility of friendly troops, an off-route antitank mine for use along highways and roads and in built-up areas, a river mine to enhance the obstacle potential of watercourses, and a short-range rocket-delivered mine utilizing an existing launcher for high density, immediately responsive mine delivery. Identified components, when integrated, will provide a system of mines and delivery means meeting Army requirements and compatible with systems being developed under Program Element 6.46.19.A, Landmine Warfare. New systems will complete Army requirements for a totally integrated mine-based barrier system.

C. BASIS FOR FY 1979 RDTE REQUEST: To complete advanced development of a common microprocessor unit for the family of scatterable mines which will allow variations in programed logic during mine assembly. Efforts will continue to validate the underwater mine concept through functional component evaluation, and the off-route mine through improved standoff lethal mechanisms and sensors. Efforts will be initiated on an improved manually emplaced mine utilizing the baseline scatterable mine, and the Surface Launched Unit Mine Rocket (SLUMINE) which consists of development of a new mine warhead for an existing rocket launcher utilizing components common to the family of scatterable mines (FASCAM).

D. OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.36.06.A Title: Landmine Warfare
DoD Mission Area: #237 - Mines and Mine Countermeasures Budget Activity: #2 - Advanced Technology Development

E. DETAILED BACKGROUND AND DESCRIPTION: The family of scatterable mines (FASCAM) is being developed utilizing baseline antitank and antipersonnel mines which can be emplaced by a multiplicity of delivery means. The components of these mines perform necessary functions to insure that landmines continue to provide the battlefield deterrent commensurate with the changing nature of modern warfare. This objective is accomplished through new developments in mine sensing and discriminating logic, lethal mechanisms, fuzing, and improved resistance to enemy countermeasures. Efforts supported by this program are then integrated into ongoing and new mine hardware systems in Program Element 6.46.19.A, Landmine Warfare, in order to meet the requirements for Army barrier systems. In addition, this program supports efforts for new landmine warfare concepts and for the determination of concept feasibility. The long range goal of this program is truly controllable barriers, highly lethal to enemy forces, while harmless to friendly troops.

F. RELATED ACTIVITIES: Engineering development of items and concepts in this program is performed in Program Element 6.46.19.A, Landmine Warfare. Developmental information is coordinated and exchanged between the Services by the Tri-Service Joint Technical Coordination Group for Bombs, Mine, and Clusters. The Department of Defense Armaments/Munitions Requirements and Development Committee monitors the scatterable mine program with a view towards avoiding Service duplication. Countermine efforts under Program Elements 6.36.19.A and 6.46.12.A, Countermine and Barriers are reviewed on a continuing basis to incorporate necessary counter-countermeasures if applicable.

G. WORK PERFORMED BY: The Project Manager for Selected Ammunition, US Army Armament Research and Development Command (ARRADCOM), Dover, NJ: is responsible for management of Landmine Warfare systems and components. Other in-house efforts are provided by: The Army Materiel Systems Analysis Agency, Aberdeen, MD, and the US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA. Contractors include: Raytheon Company, Bedford, MA; Hughes Aircraft, Fullerton, CA; Sperry-Rand, Great Neck, Long Island, NY; Martin-Marietta, Orlando, FL; and Burroughs Corporation, Paoli, PA.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Prior to FY 1975, helicopter delivered and artillery delivered antitank and antipersonnel mine systems were validated and moved into engineering development. Comprehensive systems effectiveness studies were conducted. Components for the Ground Emplaced Mine Scattering System (GEMSS) were developed. Power supplies and sensors were developed. In FY 1975, investigations on remote control components for minefield command arm/disarm were initiated. Systems effectiveness studies and component field tests continued. In FY 1976, studies continued on off-route and controliable mine systems. Design work on improved power sources and influence sensors were conducted. A prototype command and control module for scatterable mines was developed. During FY 1977, efforts were initiated on a microprocessor for mine sensor logic to assist in target discrimination and improve lethal probability. Advanced development on the Modular Pack Mine System (MOPMS) was completed. Command and control functions for the employment of scatterable mines were categorized. A long stand-off sensing mechanism was investigated.

Program Element: #6.36.06.A Title: Landmine Warfare
DoD Mission Area: #237 - Mines and Mine Countermeasures Budget Activity: #2 - Advanced Technology Development

2. FY 1978 Program: Efforts continued on a microprocessor for mine sensor logic and on counter-countermeasures for antitank sensors. Work was initiated on an improved lethal mechanism, an underwater mine, and an improved conventional mine, and an off-route mine.

3. FY 1979 Planned Program: Complete advanced development of the microprocessor for mine sensor logic, the underwater mine system, and the off-route mine. Continue efforts on improved lethal mechanisms and an improved conventional mine. Initiate advanced development of SLUMINE utilizing components common to the family of scatterable mines (FASCAM).

4. FY 1980 Planned Program: Complete advanced development on improved lethal mechanisms and the improved conventional mine. Initiate efforts on a mine system for military operations in built-up areas (MOBA) and an extended range mine system.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.07.A
Title: Army Small Arms Program
DoD Mission Area: #235 - Guns and Related Technology
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4689	695	215	250	Continuing	Not Applicable
D013	Individual Weapon System Development	434	0	0	0	Not Applicable	Not Applicable
D609	Armor Machine Gun	90	0	0	0	Not Applicable	Not Applicable
D627	Small Arms Components	1032	695	0	0	Not Applicable	Not Applicable
D640	Light Machine Gun	3133	0	215	250	Not Applicable	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program encompasses all advanced development projects that support the Army Small Arms effort. Objectives of this program include technology advances for Infantry rifles, testing of improved coaxial tank machine guns, and development of a lightweight, one-man, automatic weapon for use in the infantry squad.

C. BASIS FOR FY 1979 RDTE REQUEST: D640 - Complete development testing/operational testing on the 5.56mm MINIMI machine gun and 5.56mm XM248 machine gun as Squad Automatic Weapons (SAW). Analyze test data and conduct a Development Acceptance In-Process Review to select the weapon system to fill the Infantry's requirement for a light high-velocity SAW for entry into low rate initial production.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This program provides for Army Small Arms advanced development (AD). These projects include efforts in individual weapons, component development, crew served weapons and special purpose weapons. Major thrusts include: conceptual prototype testing of Future Rifle System candidates; burst dispersion, reliability and accuracy tests; testing and evaluation of the SAW; testing and evaluation of armor machine gun concepts for use in the tank coaxial role, and development of 40 millimeter grenade training rounds. A specific area of interest is the investigation of an improved 5.56 millimeter round which could meet both SAW and M16A1 rifle requirements. The M16A1 weapon system and the improved 5.56 millimeter ammunition are the US contenders in the NATO Small Arms Tests designed to select a second NATO standard caliber of small arms ammunition.

F. RELATED ACTIVITIES: The various projects in this program represent the only source of military small arms AD for all Services. These tasks are monitored by other Services. A Joint Service Small Arms Planning Group has been formed to insure proper coordination among the various Services Small Arms requirements.

gra. Element: #6.36.07.A Title: Army Small Arms Program
DoD Mission Area: #235 - Guns and Related Technology Budget Activity: #2 - Advanced Technology Development

G. WORK PERFORMED BY: In-house work is performed by the US Army Armament Research and Development Command (ARRADCOM), Dover, NJ, and the US Army Test and Evaluation Command (TECOM), Aberdeen Proving Ground, MD. Major contractors: Olin-Mathison Chemical Corporation, New Haven, CT; AAI Corporation, Cockeysville, MD; Maremont, Saco, ME; Ford Aerospace and Communications Corporation, Newport Beach, CA; General American Transportation (GATX), Chicago, IL; and PRC System Sciences Corporation, Englewood Cliff, NJ.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments:

a. Project D013 - Infantry Weapon Systems. Low level light sight assemblies using promethium as illuminants were provided for the M16A1 rifle. Advanced technology was applied in designing and providing M16A1 rifles for user evaluation with muzzle compensation, burst control and a single point (reflex collimator) sight. The user evaluation demonstrated improved target acquisition and hit probability. These investigations have demonstrated functional performance and potential of a mechanism for effective controlled burst fire, demonstrated a saboted cartridge and provided essential data to form a basis for further development provided an integrated weapon (4.32 millimeter point fire and 30 millimeter area fire) for initial user evaluation, and provided emperical data heretofore not available for these advanced concepts to be used in systems analysis, integration and development.

b. Project D609 - Armor Machine Gun. A blank firing attachment (BFA) for recoil operating mechanisms was demonstrated and provided in limited quantities to support user evaluation and training programs. The BFA represents a breakthrough in the state-of-the-art and provides a feasible and reliable concept for use with recoil operated weapons. Evaluation of several armor machine gun concepts have resulted in identifying mechanisms that have the potential for higher reliability and lower maintenance than standard fielded weapons. Evaluation and testing of US and foreign weapons identified the 7.62mm M60E2 machine gun and the Belgium 7.62mm MAG-58 machine gun as having the highest potential to meet the requirements for an interim armor machine gun. Comprehensive testing and evaluation of these two weapons was completed and the MAG-58 machine gun was selected as a replacement for the 7.62mm M219 machine gun presently used on various weapon systems.

c. Project D627 - Small Arms Components. Barrel wear and erosion investigations resulted in demonstrating significant improvement in the life of a rifle barrel. A chrome plated, rotary swaged 4.32 millimeter barrel has demonstrated satisfactory performance through 5 thousand rounds. Thirty millimeter grenade cartridge and component configurations were established. Cartridges were provided to support weapon concept evaluation.

d. Project D640 - Automatic Weapons. Parametric system studies identified a system that would meet the user's requirements. Through contractual and in-house efforts three US and two foreign mechanisms were submitted for user evaluation. The 5.56mm XM235 machine gun and the 5.56mm MINIMI machine gun developed by Fabrique National, Belgium, were selected for further

development. The cartridge used in the initial development was 6 millimeter. An improved 5.56 millimeter ball projectile that extends helmet penetration range and a tracer that extends visible trace range were demonstrated. These two cartridges were submitted to the NATO small caliber cartridge evaluation as contenders for NATO standardization. The feasibility of converting the 6.0mm XM235 machine gun to 5.56 millimeter was demonstrated. A 16 month advanced development contract was awarded to Ford Aerospace Communication Corporation for the development of 18 prototype 5.56 millimeter Squad Automatic Weapon (XM248) using the basic design of the 6 millimeter XM235 Squad Automatic Weapon (SAW).

2. FY 1978 Program: Evaluate state-of-the-art components in a systems environment to quantify improvements achieved in rifle performance. Design areas to be stressed are: fire control, loading devices, material application, handling and controlability.

3. FY 1979 Planned Program: Complete development testing/operational testing on the 5.56mm MINIMI machine gun and 5.56 XM235 machine gun. Analyze test data and conduct a development acceptance in process review to select the weapon system to fill the Infantry's requirement for a light high-velocity SAW.

4. FY 1980 Planned Program: Continue Army program for prototype production and investigation of light machine guns and other crew served weapon accessories.

5. Program to Completion: This is a continuing advance development program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.13.A
Title: Advanced Fuze Design
DoD Mission Area: #235 - Guns and Related Technology
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING) ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	516	825	822	1879	Continuing	Not Applicable
DE 55	Advanced Artillery and Mortar Fuzing	436	535	510	1135	Continuing	Not Applicable
DE 59	Supporting Advanced Fuze Development	80	290	312	744	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The future effectiveness of anti-armor weapons is being challenged by the development of a new and serious threat - the emergence of new improved armor. This threat not only demands new anti-tank weapons but also fuzing systems which function effectively in these new weapon systems at all angles of impact and without interference to warhead and weapon guidance system performance. The current program is investigating technology breakthroughs and impact anti-armor heat ammunition fuzing. A program will be initiated for a magnetic inductive technique which permits for the first time the ability to sense stand-off by proximity regardless of the geometry of the ammunition nose. Tribcluminescent films permit all angle sensing with no mechanical interference or wires. These and other techniques promise to counter the challenge of the threat represented in future armor warfare.

In addition a Hi-burst proximity fuze development is proceeding to assure capability for improved conventional munitions, extended range terminally guided projectile applications, and for smoke and illuminating mortar/artillery applications. Advances in electronic fuze technology now offers the opportunity to realize both hand set as well as remote set capability in electronic fuzing for artillery. The current program is exploiting this technology for the next generation 200 second hand set electronic time artillery fuze. A program design to lower the cost while improving impact sensitivity of the standard M739 point detonating (PD) fuze is in progress. A new low cost PD element is under development which will be product improved into the M739 in FY 1980.

Program Element: #6.36.13.A
DoD Mission Area: #235 - Guns and Related Technology

Title: Advanced Fuze Design
Budget Activity: #2 - Advanced Technology Development

Remote set fuzing for tank fired ammunition against both ground and air targets are under investigation. This new capability will significantly lower reaction time and enhance tank survivability. Along these same lines are the development of remote set multi-option 2.75" Rocket fuzing for helicopter systems. This development will also provide substantial improvement in operational capability both in terms of selecting from a single fuze the optimum fuze selection for maximum target effectiveness.

In support of these fuze programs there are developments to permit effective low cost evaluation of these fuzes during development or to diagnose problems arrising in standard fuzes. A program is being directed to proving out techniques and introducing proven techniques into current and future fuze engineering activities. The program is aimed at obtaining a low cost nose mounted telemetry system. Future plans call for development of techniques for measuring the more difficult fuze environments and response to in-bore launch and terminal impact. There is a technology base for these developments. The program will convert the technology into practical tools for engineering and development during fuze programs and malfunction investigations.

The need for these projects is based upon future weapon systems. These advancements will contribute to increased weapon system operational capability, improved safety, increased effectiveness against targets and at lower costs.

C. BASIS FOR FY 1979 RDTE REQUEST: Continuation of remote set fuzes for 2.75-inch rockets, and tank fired ammunition, and artillery, initiation of an improved impact fuze for artillery ammunition; and a low cost battery-less 200 second time fuze for artillery. Continuation of telemetry and impact systems for monitoring fuze component behavior when fired fitted to artillery projectiles.

D. OTHER APPROPRIATION FUNDS: None.

E. DETAILED BACKGROUND AND DESCRIPTION: This program element provides for the development of advanced fuzing technology into prototype components, systems, and substystems for artillery, morter, aerial rockets, and tank ammunition. A primary goal is to increase operational effectiveness (e.g., lethality, reliability, flexibility) of present muntions, as well as improve mission cost-effectiveness. New technologies are being applied to improve existing components, such as impact switches, safety and arming devices, and power supplies. Wireless data transmission techniques are being developed to set fuzes (to a given range or function mode), thereby improving response time and reducing human error. Another objective is the development of new fuzes to meet the requirements of advanced weapons. New fuzes are needed for multiple warhead aerial rockets and guided and unguided artillery rounds, illuminating and smoke dispensing rockets and mortar shells. An auxiliary project, DE 59 Supporting Advanced Fuze Development, supports these fuze developments via improving techniques for testing fuzes and monitoring their operation and environment, thereby reducing development time and cost.

Program Element: #6.36.13.A
DoD Mission Area: #235 - Guns and Related Technology

Title: Advanced Fuze Design
Budget Activity: #2 - Advanced Technology Development

F. RELATED ACTIVITIES: This program supports the development of fuzing to meet the requirements of munitions funded by the following program elements: 6.46.01.A, Lightweight Company Mortar System; 6.36.08.A/6.46.02.A, Weapons and Ammunition. Projects in this program are supported by exploratory development programs (6.2). Developments in this program are compatible with Tri-Service requirements to avoid proliferation of RDTE programs. All new programs are coordinated with joint technical coordinating groups.

G. WORK PERFORMED BY: In-house agencies: Harry Diamond Laboratories, Adelphi, MD; US Army Electronics Command, Fort Monmouth, NJ, US Army Armament Research and Development Command, Dover, NJ; US Army Armament Command, Rock Island, IL; and US Army Test and Evaluation Command, Aberdeen Proving Ground, MD. Contractors will include General Electric Company, Burlington, Vermont and Syracuse, New York.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Advanced development of a multi-option fuze (selectable functions include high and low air burst, impact, and delayed function after impact) for 60mm and 81mm mortars was completed. This fuze has since completed all development, and is now scheduled for production. A beehive fuze (for releasing nail-like submissiles), advanced to full-scale development. High explosive antitank fuzes in stockpile were modified following improvements developed in this program. A task to develop a non-chemical, air-driven (fluidic) power source resulted in the adaptation of this concept in several fuze developments.

2. FY 1978 Program: Transmitter hardware for the remote set fuze for tank ammunition will be evaluated. Initiation of program for evaluation of the low cost improved point detonating element for the standard M739 point detonating fuze. Final ballistic tests will be completed on the XM443/XM444 remote set fuzes for the 2.75 rocket system. Initiation of a program for development of a magnetic inductive proximity anti-armor fuze. The program stems from the magnetic technology gained within the exploratory development program for proximity sensing metal targets while being immune to brush and other non-ferrous targets.

The ARRADCOM ballistic rail gun produces a spin, set back environment of the 155mm cannon. A program is planned to apply commercially available components to obtain data on fuze performance and environment while the fuze and components thereof are in motion. A low cost nose mounted artillery telemetry mechanism will be evaluated to provide multi-channel fuze data during flight. A program will be initiated to develop a standard method for calibrating transducers during full range of projectile flight.

Program Element: #6.36.13.A Title: Advanced Fuze Design
DoD Mission Area: #235 - Guns and Related Technology Budget Activity: #2 - Advanced Technology Development

3. FY 1979 Planned Program: Effort will be conducted to evaluate prototype remote set tank ammunition fuzes. The investigation pertinent to the point detonating element for the M739 fuze will be completed. Design efforts will be initiated for a 200 second electronic time fuze for artillery ammunition. RDTE effort pertinent to the hi-burst proximity fuze will be resumed. A bread board model of the inductive fuze will be fabricated to evaluate unique configurations and sensing techniques. Transition of 6.2 technology into an advanced development program for a film coating technique to be utilized in the development of a fuze for anti-armor type ammunition. The ballistic rail gun effort concluded in FY 78 will be utilized for fuze engineering programs in FY 1980. The effort on the nose mounted telemetry will be continued.

4. FY 1980 Planned Program: The efforts on the impact sensor for the M739 fuze for artillery ammunition will have been completed, and transferred into a product improvement program for repackaging the components within the M739. The remainder of the programs discussed for FY 1979 will continue through FY 1980-81.

The transducer calibration program will continue. New starts will be initiated for impact and in-bore telemetry systems. The requirements for both impact and in-bore telemetry will be established and design concepts initiated. Design will be initiated for laboratory type equipment for evaluation of sensitivity of point detonating and point initiating-base detonating elements for fuzes used on anti-armor type ammunition.

5. Program to Completion: This a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.14.A
DoD Mission Area: #225 - Chemical-Biological Warfare Advanced Technology Demonstration

Title: Incapacitating Chemical Munitions Concepts
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	120	0	554	1134	Continuing	Not Applicable
DE73	Incapacitating Chemical Materiel	0	0	342	823	Continuing	Not Applicable
DE74	Incapacitating Chemical Agent Process	120	0	212	311	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: After the initial use of chemical agents by an adversary, the US Army must be able to selectively retaliate. This capability should include lethal chemical munitions and tactical irritants/civil disturbance devices. Chemical agent munitions with intermediate effect are also needed to provide for neutralization of mixed military and civilian targets with a minimum hazard to noncombatants. Incapacitating agent munitions provide this required flexibility. The US currently has no developed incapacitating chemical munitions. This project provides for advanced development (AD) of incapacitating agent munitions and small-scale pilot units for synthesizing incapacitating agents evolving from exploratory development. US policy on chemical warfare is to provide deterrence to the hostile use of chemical agents on US forces and, where deterrence fails, to provide a credible retaliatory capability. This project supports that stated policy through demonstration and evaluation of munitions which provide the field commander with an incapacitating agent delivery capability for selected tube artillery, rockets and missiles, and a stand-off delivery capability for Army aircraft. This provides the US with a flexible response capability in weapon selection as well as agent selection.

C. BASIS FOR FY 1979 RDTE REQUEST: To continue advanced development (AD) on incapacitating munitions concepts that have evolved from exploratory development and the processing of promising incapacitating agents which are effective via the inhalation and/or percutaneous routes. Emphasis will be placed on concepts for a deep target (40 km or greater) attack using missile warheads or air-to-ground munitions. Evolved concepts will enter the Engineering Development (ED) phase, in FY 1980.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.36.14.A
DoD Mission Area: #225 - Chemical-Biological Warfare Advanced Technology Demonstration

Title: Incapacitating Chemical Munitions Concepts
Budget Activity: #2 - Advanced Technology Development

E. DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to conduct advanced development (AD) on improved non-lethal incapacitating chemical agents which exhibit potential for casualty production through either the respiratory tract and/or penetration of environmental and protective clothing. Small scale pilot units are designed and installed to obtain process engineering data for application in future production facilities.

F. RELATED ACTIVITIES: No comparable work is done by other Services on incapacitating chemical agent processes. Each of the other Services sponsors RD on chemical weapons unique to its requirements. Information is exchanged and the efforts are coordinated through exchange of technical documents, liaison officers and joint technical coordinating groups.

G. WORK PERFORMED BY: US Army Armament Research & Development Command (ARRADCOM) Dover, NJ; and US Army Test and Evaluation Command (TECOM), Aberdeen, MD.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Advanced development (AD) was initiated on the 2.75-inch air-to-ground rocket and the 155mm artillery projectile with incapacitating agent EA 3834A. A base ejection 155mm projectile design was selected for delivery of EA 3834A. Systems effectiveness studies identified 48 submunitions as an optimum number for the projectile/agent system. Technology from the 2.75-inch Riot Control Agent CS rocket was the foundation for design work on the 2.75-inch incapacitating agent rocket. Work continued on finalizing design and functioning of the 155mm projectile and 2.75-inch rocket. Emphasis was placed on the 155mm projectile pending a decision on the caliber of the air-to-ground system being considered to replace the 2.75-inch rocket. Analysis and tests were conducted on the projectile to determine its adherence to transportation and storage safety standards. Tests showed the projectile design needed further work to provide 100 percent assurance that the agent would not be released if the projectile was involved in a catastrophic event. Submunition designs were modified and tested to improve dissemination efficiency and reduce the burning time of EA 3834A pyrotechnic mixture in the submunition. Experimental tooling was designed and fabricated for the filling of submunitions and assembly in the 155mm projectile. In FY 1975 the process for the manufacture of agent EA 3834A was optimized in a series of small pilot plant runs. Experimental tooling was designed and fabricated for the AD filling of submunition configurations. Filling, closure and assembly equipment was purchased and installed, and the munition design program was evaluated for equipment modification as required. In FY 1977, contractual efforts were initiated on: (1) the design improvement of submunitions for better efficiency and economy and, (2) on the reduction of agent release from munitions in case of accidents resulting in fire.

2. FY 1978 Program: Not applicable.

3. FY 1979 Planned Program: Advanced development will be resumed on incapacitating agent munition concepts particularly in the area of a deep target weapon (40 km or greater). Process studies of promising candidate incapacitating agents will continue.

Program Element: #6.36.14.A
DoD Mission Area: #225 - Chemical-Biological Warfare Advanced Technology Demonstration

Title: Incapacitating Chemical Munitions Concepts
Budget Activity: #3 - Advanced Technology Development

4. FY 1980 Planned Program: Advanced development will be completed on a deep target munition concept; a validation In-Process Review (IPR) will be held and the concept advanced to engineering development (ED). Effort will complete studies to provide design criteria for eventual limited production facilities to manufacture EA 3834A to be used in new families of munitions disseminating this agent (e.g., artillery, aerial systems). Candidate binary system reactants will be investigated to establish a manufacturing technology base.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.15.A
Title: Lethal Chemical Munitions Concepts
DoD Mission Area: #225 - Chemical-Biological Warfare
Budget Activity: #2 - Advanced Technology Development
Advanced Technology Demonstration

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	297	268	721	1353	Continuing	Not Applicable
DE76	Lethal Chemical Materiel	73	0	300	730	Continuing	Not Applicable
DE77	Lethal Chemical Agent Process	224	268	421	623	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Union of Soviet Socialist Republic (USSR) has developed a formidable chemical warfare capability which presents a threat to survival of US (and North Atlantic Treaty Organization (NATO)) forces. Thus, the US needs a chemical weapons development program which will provide a deterrent/retaliatory capability. This project supports that need by providing for the transition of technology concepts into advanced development materiel. Additionally, DoD has directed that the Army be the Executive Agent for the Services' chemical warfare requirements. This necessitates a program to conduct advanced development for lethal chemical munitions. There is no other program which satisfies these needs.

C. BASIS FOR FY 1979 RDTE REQUEST: To evaluate a 155mm artillary projectile with a binary lethal intermediate volatility agent (IVA) payload and a binary lethal agent warhead for the Ground Support Rocket System (GSRS). Additionally, supportive chemical process design and pilot production studies will be implemented.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to conduct advanced development of binary lethal chemical agent munitions which have advanced from exploratory development and exhibit potential for casualty production through either the respiratory tract and/or penetration of environmental and protective clothing. Small-scale pilot units are designed and installed to obtain process engineering data for application to future production facilities. Chemical agent munitions concepts that employ the binary principle are evaluated.

F. RELATED ACTIVITIES: No comparable work is done by the other Services on lethal chemical agent processes. Each of the other Services sponsor engineering development on lethal chemical agent weapons unique to its requirements. Information is exchanged and the efforts are coordinated through exchange of technical documents, liaison officers, and by joint technical coordinating groups.

Program Element: #6.36.15.A
DoD Mission Area: #225 - Chemical-Biological Warfare Advanced Technology Demonstration

Title: Lethal Chemical Munitions Concepts
Budget Activity: #2 - Advanced Technology Development

G. WORK PERFORMED BY: US Army Chemical Systems Laboratory, Edgewood, MD, which is the primary Army developer for lethal chemical agent munitions; the US Army Test & Evaluation Command (TECOM), at Aberdeen Proving Ground, MD; and Dugway Proving Grounds, Dugway, UT. Chemical Systems Laboratory performs all toxic chemical agent development work for the Department of Defense.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Data developed in the lethal chemical agent processes project were used in construction of chemical agent production facilities at Rocky Mountain Arsenal, Colorado, and Newport Ammunition Plant, Indiana. Procedures for designing equipment for filling, closing, and leak testing of chemical munitions were developed. Production techniques for lethal binary chemical agent non-toxic intermediates were studied and small quantities of some intermediates were prepared. Studies were conducted on submunition concepts for missile warhead applications. In FY 1970 advanced development was initiated on the binary GB 155mm projectile. In FY 1971, process chemistry studies for production of the binary intermediates for GB were completed and prototype filling and sealing equipment for the binary GB 155mm projectile was developed. In FY 1972, advanced development was completed on the 155mm binary GB projectile. In FY 1973, advanced development was initiated on the binary VX 8-inch projectile. Process studies for the production of binary VX were initiated. In FY 1974, advanced development on the binary lethal chemical agent 8-inch projectile was completed. Process studies and pilot production studies for binary intermediates were continued. Sub-pilot investigation of binary VX components disposal by means of incineration was conducted and feasibility was demonstrated. Criteria were developed for a pilot filling machine for loading of the binary VX 8-inch projectile, and the Development Test II (DT II) hardware filling line was completed early in FY 1974. Basic design parameters based on DT II hardware were made available for subsequent production design. In FY 1975, the exploratory development efforts on a binary intermediate volatility agent project, air-to-ground munitions, and missile and rocket warheads were closely monitored to provide the design base for advanced development effort. Design criteria for a pilot filling line for the 8-inch binary VX projectile was completed. Process and pilot production evaluations continued. In FY 1976, effort was initiated to determine feasibility of a binary lethal chemical agent warhead for the Ground Support Rocket System (GSRS). Evaluation of the lethal agent warhead for the GSRS continued during FY 1977 with emphasis on dynamic flight testing of the proposed design. Also, during FY 1977, chemical process and pilot production efforts continued relative to the binary VX 8-inch projectile program.

2. FY 1978 Program: Conduct pilot studies to evaluate binary intermediates for which process characteristics have been provided; support agent and reactant test programs; and continue emphasis on pollution abatement and waste disposal aspects of agent processes.

Program Element: #6.36.15.A
DoD Mission Area: #225 - Chemical-Biological Warfare Advanced Technology Demonstration

Title: Lethal Chemical Munitions Concepts
Budget Activity: #2 - Advanced Technology Development

3. FY 1979 Planned Program: Advanced development of the lethal agent warhead for the GSRS will resume. Dynamic stability and agent dissemination facets of the munition will be evaluated. Logistical procedures will be investigated. In mid-FY79 advanced development of a binary intermediate volatility agent (IVA) 155mm projectile will begin with emphasis on refinement of the exploratory development design and procurement/fabrication of hardware for Development Test I (DT I). Supportive efforts will be carried out to develop or improve techniques for binary agent ingredients production and process waste disposal. Increased FY79 funding over FY78 will permit additional investigations in acceptable methods for disposal of binary agent production waste.

4. FY 1980 Planned Program: Advanced development of the binary intermediate volatility agent (IVA) 155mm projectile will be completed by mid-FY80 with implementation of Development Test I (DT I) to ascertain final technical parameters in preparation for entering the engineering development phase. Similar advanced development efforts will be accomplished on the Ground Support Rocket System (GSRS) binary agent warhead. Supporting chemical process design and pilot production studies will continue with respect to both munitions.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.19.A — Title: Countermine and Barriers
DoD Mission Area: #237 - Mines and Mine Countermeasures — Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2524	2485	2836	3990	Continuing	Not Applicable
D143	Bulk Explosive System	214	0	0	0	0	214
D606	Countermine & Barrier Systems	2310	800	828	1357	Continuing	Not Applicable
D608	Countermine & Barrier Developments	0	1685	2008	2633	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is to improve the Army countermine capabilities by investigating and exploiting materials, techniques, and equipment and to examine advanced tactical barrier techniques and concepts evolving from exploratory development. Enemy minefields represent a significant threat to the battlefield mobility of Army units and are regarded as the most flexible method of creating a tactical obstacle. This program contains tasks designed to provide a family of mutually supporting countermine devices and techniques. Barrier efforts are directed towards denying or reducing enemy mobility and hardening of field fortifications.

C. BASIS FOR FY 1979 RDTE REQUEST: Requested funds provide for completion of advanced development of the vehicle mounted road mine detector and transition to engineering development. Initiate advanced development on a portable projected line charge, dust explosives for mine neutralization, hardening of vehicle components to resist mine damage, and a vehicle magnetic signature duplicator. Initiate advanced development on an overhead cover for crew-served firing positions, protective emplacements for command and control facilities, and hardening for artillery and aviation units. Funds increase over FY 1978 is the result of Army and Department of Defense emphasis on landmine warfare.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This program contains tasks designed to provide the Army with a family of mutually supporting countermine devices and techniques to meet the identified threat. Mine detection and neutralization are examined based on tactical scenarios and conditions and translated into prototype developmental items by exploiting technology achieved during Exploratory Development. The challenge of mine detection and neutralization has proven to be highly complex if the momentum of the attack is to be maintained. Detection has transitioned from the meticulous point-to-point search

to efforts to detect minefields from standoff locations. Neutralization has been redirected from a slow de-fuzing process to one of rapid neutralization by explosives or hardened components. Surface Launched Unit Fuel Air Explosive (SLUFAE) introduced the first potential for standoff neutralization. Barrier efforts are directed towards the use of the most advanced technology to deny or reduce enemy mobility on the battlefield with a goal of a ten-fold reduction in barrier system logistics. Field fortification equipment and techniques are employed for the purpose of increasing the survivability of friendly forces.

F. RELATED ACTIVITIES: Exploratory development for this program is conducted in Program Element 6.27.33.A, Mobility Equipment Technology. Engineering development efforts which result from this program are accomplished in Program Element 6.46.12.A, Countermine and Barriers. Countermine efforts are closely coordinated with the Project Manager for Selected Ammunition, Dover, New Jersey, who is responsible for the Army Mine Program.

G. WORK PERFORMED BY: The US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA, is assigned responsibility for Countermine and Barriers. In-house efforts are performed by the US Army Test and Evaluation Command, Aberdeen, MD. Contractors include: Chrysler Corporation, Detroit, MI; Goodyear Aerospace, Akron, OH; Honeywell Incorporated, Hopkins, MN; and Cubic Corporation, LaJolla, CA

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: In the area of mine detection, the potential of pulse radar, X-ray and gamma ray excitation, passive infrared devices, microwave techniques, and trace gas detection devices were evaluated. The ability of dogs to detect the explosives in landmines and booby traps was demonstrated and a canine mine detection manual was completed. A prototype evaluation of the vehicle mounted road mine detector was conducted. In mine neutralization, fuel-air explosives (FAE) were shown to be an effective minefield clearance device. A prototype launcher, the Surface Launched Unit, Fuel-Air Explosives (SLUFAE) was built, tested and transitioned to engineering development. During FY 1977, tests were conducted on components of the mine clearing roller on an expedited basis.

2. FY 1978 Program: Complete advanced development on the vehicle mounted road mine detector and transition to engineer development. Initiate advanced development on a portable projected line charge for antipersonnel minefields, dust explosives for mine neutralization, hardening of vehicle components to resist mine damage, and a vehicle magnetic signature duplicator to counter magnetic influence mines. Initiate advanced development of an overhead cover for the TOW (tube-launched, optically tracked, wire guided antitank missile system.

Program Element: #6.36.19.A Title: Countermine and Barriers
DoD Mission Area: #237 - Mines and Mine Countermeasures Budget Activity: #2 - Advanced Technology Development

3. FY 1979 Planned Program: Continue advanced development on the portable projected line charge, dust explosives for mine neutralization, and vehicle magnetic signature duplicator. Complete advanced development of hardened components to resist mine damage. Initiate advanced development of a long range metal object detector for mine detection. Initiate advanced development of tractive entanglement and foam barrier components. Initiate advanced development on an overhead cover for crew served firing positions, protective emplacements for command and control facilities, and hardening for field artillery and aviation units.

4. FY 1980 Planned Program: Complete advanced development on the portable projected line charge, dust explosives for mine neutralization, vehicle magnetic signature duplicator, and sprayed fuel-air explosives. Initiate advanced development on a dedicated countermine vehicle, demagnetization of tracked vehicles, and remote minefield detection. Continue development of tractive entanglement and foam barrier components. Complete advanced development on the hardened TOW cover and crew served firing positions.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.21.A
DoD Mission Area: #149 - Land Mobility Technology

Title: Vehicle Engine Development
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4610	3529	3051	6600	Continuing	Not Applicable
D007	Vehicle Engine Development	3285	2170	1900	3200	Continuing	Not Applicable
D395	Vehicle Transmission Steering Development	347		750	1800	Continuing	Not Applicable
A424	Other Vehicle Components	1078	768	301	800	Continuing	Not Applicable
A561	Energy Conservation -	0	0	100	800	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for advanced development (AD) of those vehicle components incorporated into ground combat and other vehicles that are not available in commercial form. High speed cross-country suspensions capable of supporting heavily armored vehicles are needed for military vehicles, as are high output low volume/weight engines. The ability to withstand battle damage is also unique to military vehicles and must be a major factor in military vehicle component development.

C. BASIS FOR FY 1979 RDTE REQUEST: Initiate work to provide a high output/low density diesel engine for a lighter class of combat vehicles relying on much higher levels of mobility and agility than do current families of vehicles. New technology will be incorporated into turbine and diesel components, which will greatly increase efficiency and reduce energy consumption.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Effective ground combat vehicles must be able to move with a high degree of reliability. This program provides for the AD of those vehicle components not commercially available. The unique requirements of military vehicles for extremely high output and efficiency dictate that propulsion systems and other components be developed by the Government or under Government auspices. To insure that such components are available for integration into future combat and other ground vehicles, vehicle components are developed within this program. The program's goals are to develop for future combat and other ground vehicles those components that will: (1) increase fuel tolerance; (2) improve fuel economy; (3) improve horsepower-per-ton ratio; and (4) improve maintenance, reliability, and availability of vehicle components.

Program Element: #6.36.21.A
DoD Mission Area: #149 - Land Mobility Technology

Title: Vehicle Engine Development
Budget Activity: #2 - Advanced Technology Development

F. RELATED ACTIVITIES: Program Element 6.26.01.A, Tank and Automotive Technology; Program Element 6.36.02.A, Advanced Land Mobility Systems Components. Foreign state-of-the-art trends in military propulsion systems are constantly monitored by the Tank-Automotive Research and Development Command, and data are exchanged with allied countries via data exchange agreements. Close coordination with any budgetary decision is physically accomplished to preclude duplication of efforts with other Services.

G. WORK PERFORMED BY: US Army Tank-Automotive Research and Development Command, Warren, MI, is responsible for the development of this program. Major contractors are: Teledyne Continental Motors, Muskegon, MI; Detroit Allison, Indianapolis, IIN; Texaco Research, Beacon, NY; AVCO Lycoming, Stratford, CT; Power-Matic, Salt Lake City, UT; American Bosch Corporation, Springfield, MA; General Electric, Pittsfield, MA; Donaldson Corporation, Minneapolis, MN; FMC, San Jose, CA; AiResearch, Phoenix, AZ; Engine Research Corporation, Cincinnati, OH; and Lockheed Corporation, Huntsville, AL.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Development and transfer of the technology for the gas turbine engine currently in the Army's new main battle tank, XM1. Conducted evaluation on advanced turbocharging, universal fuel injection and turbo-compounding on a 1500 horsepower (HP) diesel engine. Evaluations of commercial rotary and turbine engines were conducted. The stratified charge engine program was terminated when an examination of the developing commercial diesel market indicated a good possibility of a replacement jeep engine meeting Environmental Protection Agency standards could be obtained from commercial sources.

2. FY 1978 Program: Improvement and growth of the gas turbine engine will be initiated to increase efficiency and fuel tolerance. Fabrication of a high output 700 HP diesel engine for 20- to 25-ton vehicles will be initiated. A hydromechanical transmission to mate with the 700 HP diesel engine will begin fabrication.

3. FY 1979 Planned Program: The 700 HP diesel engine will continue fabrication. The hydromechanical transmission will continue fabrication. Metal Matrix Composites will be incorporated into vehicle components. A replacement track to increase track life for the M113 Armored Personnel Carrier will begin development. The Advanced Techniques for Electrical Power Systems using microprocessors, which simplifies electrical and gun control systems, will enter advanced development. A new project to examine and propose ways to conserve energy in military vehicles will be initiated.

4. FY 1980 Planned Program: Advanced turbine components which will greatly increase the fuel efficiency of the gas turbine engine for the Army's new Tank XM-1 will begin development. The 700 HP diesel engine will complete fabrication and begin evaluation together with its associated hydromechanical transmission. Proposals for energy saving materiel in military vehicles will be evaluated and promising proposals will begin hardware fabrication for feasibility demonstration.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.02.A Title: Electric Power Sources
DoD Mission Area: #442 - Logistics/General Combat Support Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4336	2709	4535	6000	Continuing	Not Applicable
DG10	Electro-Chemical Power Sources	2830	2082	2445	3000	Continuing	Not Applicable
DG11	Electro-Mechanical Power Sources	1506	627	2090	3000	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: A continuing need exists to upgrade power sources for Army use. New and advanced state-of-the-art power generators, power conditioning devices, and power controls are required by the Army to meet general purpose, special purpose, or precision power applications that cannot be met with existing items. This program supports the development of advanced technology, components, and feasibility evaluations of tactical electric power sources and associated equipment. Current engine-driven generators, particularly in the 0.5 kilowatt (KW) to 10 KW power range, have low power efficiencies, are noisy, provide heat (infrared) signatures, require excessive maintenance and are not fuel economical. Present batteries and low-power sources for various communications and electronics hardware have short lives, are undependable, and are temperature sensitive. This program provides the necessary technologies required to develop improved mechanical- and chemical-type power sources with emphasis on equipment with greater mobility, higher efficiency, reduced fuel consumption, common components, noise and heat signature reduction, and multifuel and/or non-fossil fuel capability.

C. BASIS FOR FY 1979 RDTE REQUEST: Pursue methanol fuel cell efforts of 3 KW and 5 KW capacities to satisfy requirements for a family of silent, lightweight tactical power sources. Investigate improved fuel cell system design, component materials, and logistics fuel processing. Continue efforts on ceramic components to increase the power output and fuel efficiency of gas turbine generators. Continue development of various power conditioning devices to provide required type and quality of power. Evaluate advanced concepts to reduce diesel generator fuel consumption and emissions. Conduct work on improved batteries and reliable, precision low-power generating sources.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The objectives of this program are to develop technologies and conduct feasibility demonstrations as prerequisites for engineering development (ED) of new and improved tactical military electric power sources. The projects encompass efforts on engine-driven power generation (electromechanical power), fuel cells and batteries

(electrochemical power), and other power-related devices and technology to improve efficiency, type, and quality of power required to support Army tactical systems. Power requirements range from very low outputs (milliwatts) to moderately high outputs (hundreds of kilowatts). To satisfy low power demands, new type batteries are being developed which will provide high energy densities, long storage life, operate over wide temperature ranges, and are smaller and lighter than present equivalent capacity batteries. Higher power needs will be met by the latest state-of-the-art engine-driven generators and fuel cells with emphasis on meeting Department of Defense goals for standardization of power generation equipment to achieve benefits of component commonality, reduced logistics support requirements, lower life-cycle costs, and improved fuel economy.

F. RELATED ACTIVITIES: The Army maintains continuing coordination with the other Services; Department of Energy; National Aeronautics and Space Administration; Department of Health, Education, and Welfare; and Department of Transportation through the Interagency Advanced Power Group, the Power Information Center, and the Department of Defense Project Manager for Mobile Electric Power. The Power Sources Conference sponsored by the US Army Electronics Research and Development Command provides a forum for exchange of information between government, academic, and industrial researchers. Additionally, the Joint Deputies for Laboratories (Panel for Batteries and Fuel Cells) assures coordination between the Services on programs concerning battery and fuel cell systems. Advanced Development items in this program element progress to engineering development in Program Element 6.47.14.A, Tactical Electric Power Sources. Related basic research is conducted in Program Element 6.11.02.A, Project AH47, Electronic Devices Research, and Project AH51, Combat Support. Exploratory development is conducted in Program Element 6.27.33.A, Mobility Equipment Technology.

G. WORK PERFORMED BY: In-house work is performed by the US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA, and the US Army Electronics Research and Development Command, Fort Monmouth, NJ. Known and/or possible contractors include Englehard Industries, Menlo Park, NJ; Illinois Institute of Technology Research Institute, Chicago, IL; Energy Research Corporation, Bethel, CT; United Technology Corporation, Hartford, CT; Delco Electronics Division of General Motors, Goleta, CA; Solar Division of International Harvester, San Diego, CA; Mallory Battery Company, Terrytown, NY; and TRW, Incorporated, Redondo Beach, CA.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Major technology improvements of components of gas turbine engines have been made and, where applicable, have been incorporated in the engineering development (ED) design for the 10 kilowatt (KW), 60 Hertz (Hz) turbine generator. These improvements also are applicable to future turbine generator sets. Preliminary investigations of unique ceramic materials have demonstrated the potential of ceramic components to achieve significant improvement in performance and reduced fuel consumption of present state-of-the-art turbine generators. Tests of an initial prototype of a 15 KW general purpose power conditioner, which will provide regulated alternating current (AC) or direct current (DC) power from utility lines or engine generator sources, have confirmed the applicability of power conditioners to improve military power supply efficiency. Advanced development (AD) has been completed on an inverter for the 1.5 KW fuel cell member of the Silent Lightweight Electrical Energy Plant (SLEEP) family, and efforts were begun on a 3KW inverter. AD efforts were continued on the 1.5 KW methanol fuel cell to

resolve a cell stack reliability problem prior to entry into engineering development (ED). Lithium-type batteries demonstrated superiority over existing conventional batteries at temperatures to -40°F. Efforts were continued to improve designs of 100 watt and 500 watt thermoelectric generators as candidate low power multifuel silent power sources. Design of a 3.2 kilowatt (KW) alternating current (AC) to direct current (DC) power processor feasibility model has been completed.

2. FY 1978 Program: Conduct efforts to upgrade capability of a 10 KW gas turbine engine to a 15 KW output using ceramic bearings, nozzle, and combustor components. Evaluate advanced silencing techniques for a 10 KW turbine generator set. Continue AD of 1.5 KW methanol fuel cell for silent power, and conduct decision review for entering ED phase. Begin efforts to improve processing of logistics hydrocarbon fuels for fuel cells as a viable option to use of methanol. Continue efforts to improve fuel cell components to improve reliability. Modify design of lithium-type batteries for safe and reliable operation for high energy requirements. Continue redesign of 100 watt and 500 watt thermoelectric generators. Begin design of a feasibility model 2.5 KW AC to DC converter/regulator for use in military electronic digital equipment and electronic systems.

3. FY 1979 Planned Program: Efforts to upgrade a 10 KW turbine generator to 15 KW output using ceramic components will be continued. Principles of exhaust regeneration will be examined to reduce turbine engine fuel consumption. Evaluations of improved noise reduction housings for varying capacity engine generators will be initiated. Efforts to improve diesel generator components to reduce fuel consumption and harmful emissions will be started. AD will be initiated on 3 KW and 5 KW fuel cell members of the silent power family. A demonstration test of a 1.5 KW hydrocarbon fuel cell will be conducted, and efforts to improve fuel processing and components for fuel cells will continue. Safety, transportation, and disposal criteria for lithium organic batteries will be developed. Specifications for improved AD prototypes of 100 watt and 500 watt thermoelectric generators will be developed and fabrication of a test model will be initiated. A prototype 2.5 KW AC to DC converter/regulator will be designed and fabricated. Increase in funding for FY 1979 over FY 1978 is to accomplish key objectives for fuel cell silent power, improved generator efficiency and reduced fuel consumption efforts for turbines, and noise reduction for large capacity engine generators.

4. FY 1980 Planned Program: Efforts will be continued to: improve turbine engine - driven generators; develop improved fuel cell system component designs to meet silent lightweight power needs; develop simple hydrocarbon fuel processing technology for fuel cells; develop improved noise reduction and low emission means for existing high power engine generators; develop power conditioning devices for general purpose applications; and develop precise uninterrupted and reliable low power sources, new batteries, thermoelectric generators, and control devices for communications and electronics systems.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.10.A
DoD Mission Area: #213 - Search and Reconnaissance, Surveillance and Target Acquisition

Title: Night Vision Advanced Development
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	13651	11071	8437	18300	Continuing	Not Applicable
NK30	Night Vision Devices	13651	11071	8437	18300	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army must have an improved capability to fight at night so that it can successfully engage in future conflicts which will be 24-hour full scale clashes employing at night virtually all the air and ground weaponry employed during daylight. Massive firepower and pinpoint weapon accuracy will be useless at night and during periods of limited visibility unless targets can be acquired. The objective of this program is to apply recent advances in technology to develop and reduce the life cycle cost of night sights and techniques that will provide the Army with the necessary improved night and limited visibility fighting capability. With this capability the Army will be able to confront a foe that plans and trains to continue combat operations during periods of darkness and limited visibility. The Night Vision devices developed are used for the weapons of the individual soldier (rifle and crew served weapon sights, goggles), anti-tank missile systems (TOW and DRAGON Night Sights), helibornе and combat vehicle applications.

C. BASIS FOR FY 1979 RDTE REQUEST: While the current (common module) first generation of infrared thermal systems provide high performance for surveillance, target acquisition and fire control, their technology places a limitation on the size and weight below which manportable thermal night sights may be reduced. Development and fielding of a second generation of thermal imaging systems with less than one-half the weight, size and cost of our current generation devices will allow the US Army to meet and counter the Soviet threat. To reduce the vulnerability of Army aircraft, to reduce the time of target acquisition, identification and engagement, and to increase the accuracy of fire control and survivability of both aircraft and ground armored vehicles, advances in technologies for current generation night and poor weather viewing systems will be developed. A critical portion of this technology is the implementation of counter-measures and counter-counter-measures as they apply to all the enemy's possible methods of rendering these indispensable fire control systems ineffective.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.37.10.A
DoD Mission Area: #213 - Search and Reconnaissance, Surveillance and Target Acquisition

Title: Night Vision Advanced Development
Budget Activity: #2 - Advanced Technology Development

E. DETAILED BACKGROUND AND DESCRIPTION: In the infrared area development of a family of modules utilizing second generation 3-5 micron technology for lightweight manportable systems will continue. The Army is currently in procurement of manportable systems which use current generation 8-12 micron parallel scan (common module) technology. The use of common modules is resulting in substantial procurement savings and life cycle cost reduction. The 8-12 micron systems represent a quantum improvement over previously developed devices, but their shortcomings of size and weight will be addressed by the second generation technology. From this new technology will evolve a class of systems which will have no logistical requirement to refill bottles of compressed air for cooling, be one-half the weight of the first generation systems, and be able to satisfy extended range requirements. In the combat vehicle area the basic Tank Thermal Sight, which makes use of the First Generation Thermal Imaging Common Modules, will have the "time to kill" reduced by a factor of two or more by the use of automatic tracking and signal processing. A prototype model of a low cost far infrared driving periscope will be procured and evaluated. Use of far infrared technology for driving will increase ability of vehicles to navigate under conditions of low visibility (fog, smoke, etc.). Feasibility prototypes of the Advanced Heavy Anti-Tank Missile System (AHAMS) Night Sight will be developed and their applicability to an Advanced Medium Antitank Weapon System (AMAWS) investigated. The performance of the passive thermal night sights of tanks is degraded by heavy smoke or fog. To remove this limitation, STARTLE (Surveillance Target Acquisition Radar for Tank Location and Engagement), which integrates active millimeter radar and a passive thermal sight will be developed. The passive sight will be used the majority of the time, with the active radar being employed only when thermal sight performance is degraded by extreme reductions in visibility.

F. RELATED ACTIVITIES: The Army's Night Vision Laboratory has been assigned the responsibility to coordinate all night vision technology based programs within the three Services to avoid duplication and to ensure that maximum use is made of resources and capabilities within the DoD community. Additionally, active international technical interchange is maintained with NATO through Panel VI (Combat Intelligence) of the NATO Army Advisory Group (NAAG). The Federal Republic of Germany is currently prepared to sign the final negotiated Memorandum of Understanding (MOU) for the sale and co-production of the Standardized Common Modules. Germany's plans to use Common Modules on their LEOPARD I & II, MARDER, and LUCHS vehicles is a significant step forward in NATO standardization of Thermal Imaging Systems.

G. WORK PERFORMED BY: Work is performed by the US Army Night Vision Laboratory, Fort Belvoir, VA, with contractor assistance. Representative contractors include: International Telephone and Telegraph Corporation, Fort Wayne, IN; Varian Associates, Palo Alto, CA; Texas Instruments, Inc., Dallas, TX; Aeronutronics Ford Corporation, Newport Beach, CA; and Hughes Aircraft, Culver City, CA.

Program Element: #6.37.10.A
DoD Mission Area: #213 - Search and Reconnaissance, Surveillance and Target Acquisition

Title: Night Vision Advanced Development
Budget Activity: #2 - Advanced Technology Development

II. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Third Generation Image Intensification Tubes with high sensitivity have been fabricated and given limited field testing. Low Cost Goggle Tube designs have been hardened. The performance qualification of first generation Infrared Common Module competitive sources has been completed. The fabrication of second generation infrared common modules has been initiated. Neodymium laser rejection filter for image intensifiers demonstrated. Closed cycle cooler for manportable, Night Observation Device Long Range (NODLR) developed. Remotely Piloted Vehicle (RPV) sensors procured.

2. FY 1978 Program: Fabrication and testing of tubes for Low Cost Night Vision Aids (LCNVA). Award contract for LCNVA (goggles) using the low cost tubes. Complete improvements of first generation infrared common modules that will result in increased maintainability and durability, through use of solid state circuitry. Pyroelectric vidicon developed for perimeter security transitions to Full Scale Development. Evaluate thermal imaging for combat driving. Qualify split cycle cooler for the Night Observation Device, Long Range (NODLR). Approval of Letter of Agreement for the LCNVA. Flight test of Third Generation Pilots Night Vision Goggles.

3. FY 1979 Planned Program: Develop modules using advanced technologies for second generation 3-5 micron systems. Initiate program for infrared jammer sources. Integrate electronic signal processing into improved combat vehicle sight to result in decreased "time to kill". Award contract for a far infrared driving periscope if FY 1978 evaluations are favorable. Airborne flight test of COBRA helicopter with thermal imaging common modules to provide night and limited visibility capability to TOW antitank missiles mounted on COBRA helicopters. The decrease in FY 1979 from FY 1978 is due to delay of contractual efforts for LCNVA, Pilots Night Vision Goggles, and an advanced night sight required for helicopter fire control, which will be picked up in FY 1980.

4. FY 1980 Planned Program: Complete advanced development of pyroelectric vidicon for drivers periscope. Evaluate prototype of advanced combat vehicle night sight. Validation of counter-counter-measures for night sights. Evaluate feasibility model of Advanced Heavy Antitank Missile System Night Sight. Development and Operational Test I, In-Process Review, and transition to Full Scale Engineering Development for infrared individual weapon sight. Evaluate second generation thermal sight for helibornе operations. Evaluate demonstration model of STARTLE (Surveillance Target Acquisition Radar for Tank Location and Engagement). The increase in FY 1980 over FY 1979 is to provide funds for procurement of validation models of night sights using low cost third generation tubes (LCNVA, Pilots Night Vision Goggles) and second generation thermal modules (helicopter fire control).

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.19.A
DoD Mission Area: #213 - Search and RSTA

Title: Special Purpose Detectors
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1390	0	900	3300	Continuing	Not Applicable
DK72	Radars	0	0	900	3100	Continuing	Not Applicable
DK75	Optical	1390	0	0	200	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Advanced development of surveillance, target acquisition devices is conducted under this program. The objective is to provide the Army with an improved capability to locate and engage targets during all weather conditions. During the 1983-1990 time frame, NATO forces will be unable to match the numerical superiority of the Warsaw Pact forces armor and fire power. Soviet doctrine is to exploit firepower by echeloning large numbers of armor and mechanized infantry in depth over a narrow front. Electronic countermeasures and battlefield obscuration will be used to cover movements. To counter this threat, US forces must have an all weather, long range, highly mobile, ground based surveillance radar system to acquire moving targets in support of fire support and intelligence functions.

Correction of these deficiencies and fulfillment of this requirement is the Battlefield Surveillance and Target Acquisition Radar (BSTAR) objective.

C. BASIS FOR FY 1979 RDTE REQUEST: DK72 funding will provide for initiation of the Battlefield Surveillance Target Acquisition Radar (BSTAR) in response to an Army requirements document (Letter of Agreement) signed in July 1977. Radar specifications will be prepared and coordinated with the user community, and a contract awarded for Advanced Development models of the BSTAR.

Program Element: #6.37.19.A
DoD Mission Area: #213 - Search and RSTA

Title: Special Purpose Detectors
Budget Activity: #2 - Advanced Technology Development

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to establish the operational/tactical feasibility of a system of equipments which can provide the Army with a greatly improved and new capability in surveillance, target acquisition and vehicle defense. In FY 79, development of the Battlefield Surveillance Target Acquisition Radar (BSTAR), a lightweight, mobile, all weather radar to meet the needs of the artillery and intelligence communities will be initiated. The BSTAR will be capable of detecting and locating enemy targets with sufficient accuracy to provide effective artillery fire adjustment and also to support intelligence operations within the division. The Scanning Optical Augmentation Locator (SOAL) will provide the capability

F. RELATED ACTIVITIES: Program Element 6.27.03.A, Combat Surveillance, Target Acquisition and Identification; Program Element 6.27.09.A, Night Vision Technology; Program Element 6.27.26.A, Army Support of Defense Advanced Research Projects Agency (DARPA); Program Element 6.27.15.A, Tactical Electronic Warfare/Intelligence Technology. These activities provide technological studies/ experiments which are provided to projects funded within this program element.

G. WORK PERFORMED BY: In-house developing organization for all projects is the US Army Electronics Research and Development Command, Fort Monmouth, NJ. Contractors will be selected at a later date.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Testing completed for Artillery Launched TV Target Location System, using a hardened TV camera and a modified 155mm illuminating projectile. Procurement package for advanced development of SOAL was prepared.

2. FY 1978 Program: Not Applicable.

3. FY 1979 Planned Program: Prepare technical specifications and procurement package for BSTAR. Coordinate specifications with Army and user community. Award multiple source contract for Advanced Development model(s) during 4th Qtr FY 1979. The increase in funds for FY 79 over FY 78 is due to the initiation of this project. No funding was available in FY 78.

4. FY 1980 Planned Program: Complete fabrication of Advanced Development model(s) of BSTAR, and develop test plan for Development Test/Operational Test I (DT/OT I) covering artillery and intelligence operations. Begin two-year effort to integrate and test Scanning Optical Augmentation Locator into an Complete SOAL integration; prepare for DT/OT I.

5. Program to Completion: Conduct DT/OT I for BSTAR. Hold in-process review (IPR) and approve initiation of contract award for six engineering development models. Conduct DT/OT II in FY 1982 followed by Development Acceptance In-Process Review (DEVA IPR) and award of production contract in FY 1985. Complete DT/OT I for SOAL in an

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.21.A
DoD Mission Area: #225 - Chemical-Biological Warfare Advanced Technology Demonstration

Title: Chemical Defensive Materiel Concepts
Budget Activity: #2 - Advanced Technical Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4134	3517	10792	13316	Continuing	Not Applicable
	Quantities						
	5 Gal Decontamination Apparatus						250
	Simplified Collective Protection Shelter						74
	Residual Gas Life Indicator						65
	NBC Collective Protection Systems						12
	Detector Kit for Chemical Agent in Water						506
	Automatic Liquid Agent Detector						175
	Remote Chemical Agent Alarm						56
	Chemical Attack Warning System						1050
DE8C	Individual Cml Protection Materiel	3492	0	0	830	Continuing	Not Applicable
DE81	Cml Decontamination Materiel	21	1250	1869	2300	Continuing	Not Applicable
D601	Cml Detection & Warning Materiel	621	2267	4683	4840	Continuing	Not Applicable
D604	Collective Cml Protection Materiel	0	0	4240	5346	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: There is an urgent need to provide all services with an improved rapid detection and warning systems which will provide US forces with early warning of an approaching chemical agent attack, and improved individual and collective protective materiel and equipment to protect against chemical attack, whether in vapor or liquid aerosol form. The Army has recently been assigned executive agency responsibility for conducting chemical biological defense research and development DoD-wide. This PE covers defensive systems and equipment to protect individuals and groups from chemical agents by providing: protection for the respiratory system and body surface; manual and automatic detection and warning device that respond to toxic agents in all forms on all surfaces; means to decontaminate skin, clothing, equipment, terrain, food and water; and the development of collective protection for shelters, armored vehicles, vans and associated equipment. Failure to correct these NBC defense deficiencies would seriously jeopardize the survivability of US forces in the event of a chemical attack.

Program Element: #6.37.21.A
DoD Mission Area: #225 - Chemical Biological Warfare Advanced Technology Demonstration

Title: Chemical Defensive Materiel Concepts
Budget Activity: #2 - Advanced Technical Development

C. BASIS FOR FY 1979 RDTE REQUEST: AD of the Remote Sensing Alarm and the Personnel Decontamination System will continue. The intermediate size decontamination apparatus will be type classified. The most promising concepts and prototype hardware for the residual gas life indicator, simplified collective protection for field shelters will move into AD. Prototype collective protection materiel for armored vehicles will be fabricated and tested to determine relative worth for future application.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The objective of this element is to conduct Advanced Devlopment for all services on rapid detection and warning systems, and protective materials and equipment to warn of the presence of and to protect against chemical attack. This element covers defensive systems and equipment to protect individuals from chemical agents by providing: protection for the respiratory system and all body surfaces; manual and automatic detection and warning devices that respond to toxic agents on all surfaces, in the atmosphere, and in food and water; and means to decontaminate skin, clothing, equipment, terrain, food, and water. This element also provides for the development of collective protection equipment/materiel to provide rest and relief to personnel performing certain headquarters and communications functions, and for certain, armored vehicle crews to relieve the stresses and restrictions inherent in wearing individual protective equipment while performing their mission in an active chemical environment.

F. RELATED ACTIVITIES: The approval of the Memorandum of Understanding with Canada for protective mask canisters is pending. Similarly, conversion of the Army approved Required Operational Capability (ROC) for the New Protective Mask to a Joint Service Operational Requirement for multi-service application is pending.

G. WORKED PERFORMED BY: US Army Chemical Systems Laboratory, Aberdeen Proving Ground, MD; US Army Large Caliber Weapons Systems Laboratory, Picatinny Arsenal, Dover, NJ; Arctic Test Center, Fort Greeley, AL; Tropic Test Center, Panama. Contractors are Sierra Engineering Company, Sierra Madre, CA; Avo Company, North Bayshore, Long Island, NY; Gentry Corporation, Carbondale, PA; Utility Research Company, Montclair, NJ; and Block Engineering Cambridge, Mass.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Efforts during the past two years on the Remote Sensing Alarm have been limited to intermittent preparation for, and conduct of comparative testing of two alternative technical approaches: Long PATH INFRARED (LOPAIR), and Forward Looking INFRARED (FLIR). The new protective mask completed Advanced Development phase and entered Engineering Development September 1977. Extensive testing of the new mask has been conducted to determine agent penetration resistance capability and material compatibility with field contaminants. An intensive effort is being pursued to improve the protective mask coating at the environmental extremes (-2°F, 125°F) with respect to crazing and softening, respectively.

Program Element: #6.37.21.A
DoD Mission Area: #225 - Chemical Biological Warfare Advanced Technology Demonstration

Title: Chemical Defensive Materiel Concepts
Budget Activity: #2 - Advanced Technical Development

2. FY 1978 Program: Comparative testing of the LONG PATH INFRARED and Forward Looking Infrared (FLIR) is scheduled for 1QFY78. The most promising concepts and prototype hardware for a Personnel Decontaminating System, Field Decontaminating System, Detector Kit for Chemical Agents in water and a product improvement program for the M19 Sampling Kit will progress into Advanced Development (AD).

3. FY 1979 Planned Program: Initiate AD on Automatic Liquid Agent Detector (ALAD). AD effort on the ALAD includes the evaluation of detector grids and selection of detector configuration for the neon efficient collection and design electronics. Conduct AD on the Remote Sensing Alarm, XM21 (LOPAIR). Sufficient prototypes (LOPAIR) will be fabricated to expedite field testing and evaluation. Initiate AD on the Detector Kit for Chemical Agents in Water. Prototype hardware of this kit will be fabricated for design testing and documentation effort. Initiate AD on the Chemical Attack Warning System (CAWS). Prototype hardware (CAWS) will be fabricated for design testing, evaluation of reliability, availability and maintainability, and human factors engineering. Initial drafts of manuals and tests procedures and equipment will be completed/started on all of the above items.

4. FY 1980 Planned Program: Advanced development will continue in FY 1980 for the Advanced Chemical Agent Detector and will be completed for the Field Decontamination System, and the Detector kit for chemical agents in water. Advanced development will continue on the starts begun in FY 1979. Air Force and Navy requirements will be initiated as required.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.25.A
Title: Remotely Piloted Vehicles (RPVs)/Drones
DoD Mission Area: #214 - Target Exploitation
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5508	9211	2191	3230	Continuing	Not Applicable
DK61	Remotely Piloted Vehicles/ Drones	5508	9211	2191	3230	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Develop small, low cost, easily operated Remotely Piloted Vehicles (RPVs) deployable in forward tactical areas which extend the eyes of the Brigade and Division commanders to the range of their artillery, increase the effectiveness of their direct support firepower, and provide laser designation for laser guided weapons. Effort will be directed toward second generation missions with different interchangeable payloads such as night and adverse weather sensors, communication relays, communication and non-communication jammers, and multiple control capability. These RPVs will complement the larger and more sophisticated Air Force RPV systems.

C. BASIS FOR FY 1979 RDTE REQUEST: RPV sensor developments will continue with emphasis on programs in near infrared and infrared sensors on the advanced platforms designed to meet RPV missions for the 1980s timeframe. These platforms will utilize advanced optical designs, improved stabilization and autotracking and laser integration. Program will begin in FY 1978 and will provide continuing demonstrations of technology relevant to RPVs. In the command and control effort, an anti-jam data link will be completed. An effort will be made to take advantage of the United Kingdom (UK) RPV effort by investigating mutual requirements particularly in propulsion, command and control, sensor, and survivability techniques thru established US/UK Ad Hoc Working Groups. The Electronic Warfare (EW) program for the mini-RPV will continue and will use communications single channel and barrage jammers and non-communication jammers which have been developed separately. These jammers will be initially tested on a piloted aircraft and then tested on a RPV. Continued flight testing of equipment resulting from the supporting technology programs will be conducted in manned aircraft and RPVs in order to reduce technological and schedule risks. As various sensors meet the users requirements, they will be developed and fielded as individual packages.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The objective of the Army RPV program is to field a mini-RPV system that has high reliability and is cost effective for reconnaissance, target acquisition and target designation missions. The second generation system will be capable of night/adverse weather operation and will have interchangeable payloads for other missions. The

major activity has been the AQUILA System Technology Demonstrator which provided the means to determine organizational and operational concepts utilizing mini-RPVs and determined those subsystems that need further research and development. The demonstration included 23 RPVs, 2 ground control stations, 2 launchers and recovery systems. There were interchangeable sensors varying from unstabilized daylight TVs to stabilized daylight TV with autotrack capability and laser range finders and designators. The RPV has a 12 foot wing span, a 6 foot fuselage, a gross weight of 146 pounds, an 11 horsepower McCulloch engine, cruises at speeds between 49 and 103 knots, and is recovered in a net assembly. An important contribution of the AQUILA has been to demonstrate that the RPV is not simply a large model airplane with a sensor. The integration of all the requirements of a militarized RPV into a realistic system is a challenge which requires careful design and detailed engineering. Many of the problems uncovered during the testing to date have resulted in the initiation of technology programs in order to determine the solutions prior to Engineering Development. An anti-jam data link is required to counter the high electronic warfare threat. A task to improve the survivability of the RPV system is underway. An engine fabrication program will provide more horsepower, lower costs and improve engine reliability. Various recovery techniques are being studied. Design studies have been contracted to reduce the weight and cost of the sensors which may constitute 50 percent of the total RPV cost. Contracts to develop lightweight night sensors have been issued. A program to demonstrate a millimeter wave radar using off-the-shelf components is in process which may provide an adverse weather capability and may also act as an illuminator for millimeter guided weapons as they are developed. A program to demonstrate tactical communication jamming is underway. Smaller projects investigating low cost actuators, alternators and propellers are also in process. Hardware developed under these tasks will be incorporated into the AQUILA RPV as applicable and then directed into Engineering Development and production systems as the technology permits.

F. RELATED ACTIVITIES: Within the Army, Exploratory Development of RPV technology is conducted under Program Element (PE) 6.27.32.A, RPV Supporting Technology. Engineering Development of the first generation RPV will be conducted under PE 6.47.30.A, Remotely Piloted Vehicles. The Air Force RPV programs consisting of PE 6.37.39.F, Advanced RPVs, and PE 6.47.46.F, Expendable Drones, are being monitored. To preclude duplication of effort between services, a quarterly Joint Technical Coordinating Group (JTCG) meeting is held between the Army, Navy, and Air Force RPV program managers. The Marine Corps is monitoring the Army program closely. A Memorandum of Understanding with the United Kingdom will initiate data exchanges on RPVs. At the current time there is no duplication of effort in mini-RPVs within the Services.

G. WORK PERFORMED BY: The US Army Electronics Research and Development Command, Fort Monmouth, NJ; US Army Missile Research and Development Command, Huntsville, AL; Research and Technology Laboratories, Aero Mechanics Laboratory, Moffett Field, CA; Applied Technology Laboratory, Fort Eustis, VA; and US Mobility Equipment Research and Development Command, Fort Belvoir, VA. Contractors actively participating in the RPV development are Lockheed Missiles and Space Company, Inc., Sunnyvale, CA; Aeronutronic-Ford, Newport Beach, CA; Teledyne Ryan, San Diego, CA; Texas Instruments, Dallas, TX; Honeywell, Minneapolis, MN; Harris Corpporation, Melborne, FL; Norden, Norwalk, CT; Teledyne Continental Motors, Mobile, AL; Aerotech Industries, Auburn, AL; and Developmental Sciences. Inc., Industry, CA. There are six other contractors that have approximately $600 thousand worth of contracts.

Program Element: #6.37.25.A
DoD Mission Area: #241 - Target Exploitation

Title: Remotely Piloted Vehicles (RPVs)/Drones
Budget Activity: #2 - Advanced Technology Development

II. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: In FY 1973 and FY 1974 the Remotely Piloted Aerial Observer/Designator System (RPAODS) program yielded parametric data in such areas as detectability, survivability, target search and acquisition, target tracking and designation and imagery transmission links. In late FY 1974, the AQUILA program was established to utilize data obtained from RPAODS, incorporate general requirements established by the user and develop a program to demonstrate the technology, determine the cost-effectiveness of the system, and establish the operational and organization concepts necessary to operate mini-RPVs in the field. Design and some fabrication took place in FY 1975. In FY 1976 the Aeronutronic-Ford (formerly Philco-Ford) PRAIRIE II RPV successfully lased a target tank and a laser seeking Cannon Launched Guided Projectile (CLGP) scored a direct hit on the target tank. An initial effort of integrating a small, lightweight jammer into a mini-RPV was started. A contract was let for an anti-jam data link to provide hardware to be integrated into two AQUILA RPVs and one ground station. Contractor flight testing of AQUILA was initiated in December 1975 in California. By April 1976, 13 flights had been conducted. Eight of these flights resulted in damage to the RPVs. Problems were related to a premature engineering freeze to meet schedule and infant mortality of parts. Fabrication of the remainder of the RPVs was stopped and an Army Review team formed for a reliability review. Over 30 changes were made to include extended ground testing. Successful automatic launch, flight, navigation and recovery were then demonstrated in FY 1977. The AQUILA has demonstrated target detection, recognition and laser rangefinding/designating with over 130 flights. The AQUILA Contract is expected to conclude in December 1977. The objectives of the program were met, with many of the identified problem areas resulting in parallel programs to develop better hardware and different solutions. Testing at Fort Huachuca, Arizona, was conducted under simulated field conditions in order to determine the Remotely Piloted Vehicles (RPVs) place in the force structure and how it should be integrated into command, control and targeting systems. Development was continued in propulsion, launch, and recovery techniques, servo actuators, manufacturing, and improved design concepts. The millimeter surveillance radar was tower tested. Emphasis was placed on technology which will lead to lower cost for infrared imagers. Sensors and sensor subsystem components were tested using a manual aircraft as a test bed. A tunable jammer and a barrage jammer were tested.

2. FY 1978 Program: The AQUILA demonstration will be completed and efforts directed toward entering the Engineering Development phase under Program Element (PE) 6.47.30.A, Remotely Piloted Vehicles will be initiated. Information acquired from this demonstration will be used in the development of the Required Operational Capability (ROC). The hardware developed and fabricated under the prior year's technology programs will be demonstrated. These efforts include the anti-jam data link and propulsion. Those items successfully demonstrated will be included in the specifications for Engineering Development Phase. Developmental efforts already started in the areas of lasers, engines, servoactuators, propellers, launch and recovery techniques and an anti-jam data link in the J-Band will continue. Work in the RPV vulnerability/survivability area will continue. A survivability test will be conducted with the AQUILA flying against threat weapon systems. A COPPERHEAD (cannon launched guided projectile)/AQUILA test will be performed to demonstrate compatibility. User testing of AQUILA was completed in early FY 1978 and engineering design testing is continuing.

Progarm Element: #6.37.25.A
DoD Mission Area: #214 - Target Exploitation

Title: Remotely Piloted Vehicles (RPVs)/Drones
Budget Activity: #2 - Advanced Technology Development

3. FY 1979 Planned Program: Development of the data link and night/adverse weather sensors will be the major thrust. Forward Looking Infrared (FLIR) testing will continue. Work will continue on video processing and other areas where shortcomings are found during the testing of the AQUILA. Work in Electronic Warfare will be expanded, with jammers tested in a manned aircraft and in Remotely Piloted Vehicles (RPVs). It is anticipated that technology will be exchanged with the British in FY 1979. Funds required are less than in FY 1978 because AQUILA contracts will have been completed and contracts for Engineering Development under Program Element (PE) 6.47.30.A, Remotely Piloted Vehicles, will begin.

4. FY 1980 Planned Program: The FLIR and jammer programs will be continued. The millimeter radar and night launch and recovery programs, which will be used in second generation RPVs, will be started. Use of the RPV with REMBASS (Remotely Monitored Battlefield Sensor System) will be investigated. Communications relay and radiac survey work by an RPV will be investigated.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.31.A

Title: Military Personnel Performance Development and Assessment

DoD Mission Area: #222 - Training and Personnel Technology

Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4543	4024	4786	6431	Continuing	Not Applicable
A768	Manpower Accessions and Retention Systems	1112	1074	836	1825	Continuing	Not Applicable
A770	Performance-Oriented Individual Skill Development & Evaluation	2103	1450	2400	2490	Continuing	Not Applicable
A776	Role of Women in Army	1126	1100	800	1316	Continuing	Not Applicable
A781	Applied Techniques for Organizational Effectiveness	202	400	750	800	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Population changes and other demographic trends in U.S. society are critically affecting ability of the Army and Reserves to recruit and retain quality and quantity of soldiers needed to meet anticipated Army requirements. This advanced development effort is particularly needed at a time when advanced systems technology and equipment design is so sophisticated that increasingly higher skills are required of soldiers. This advanced development program is directed toward meeting the following needs: (1) providing sufficient high quality personnel to fill the Army's requirements, (2) improving relevance and cost-effectiveness of individual training, (3) optimizing utilization of women in the Army, (4) applying new leadership and managerial techniques to enhance effectiveness of units and their leaders, and (5) improving quality of the individual's life and career in the Army.

C. BASIS FOR 1979 RDTE REQUEST: Army schools and centers generate performance packages for cost-effective decentralized operational unit training -- instructional and administrative materials for on-site training programs. Project A770 provides advanced development for producing non-resident and on-the-job training and evaluation packages and individual excension training systems. This project will continue research on critical operational problems such as how to reduce first-term enlisted personnel attrition, impact of increased utilization of women, how to increase recruitment in the Reserve Components, and how to increase effectiveness of complex Army organizations.

D. OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: 6.37.31.A

Title: Military Personnel Performance Development and Assessment

DoD Mission Area: #222 - Training and Personnel Technology

Budget Activity: #2 - Advanced Technology Development

E. DETAILED BACKGROUND AND DESCRIPTION: Advanced development effort is required to insure that the Army has an adequate supply of quality personnel, an individual training system to produce effective individual performance, a personnel placement system that assures soldiers are operationally effective in their unit assignments, and an environment that motivates the soldier to perform at his ability level. Major advanced development efforts will be conducted in the following critical areas: enlisted accession, assignment, attrition, retention and reenlistment; officer recruitment, training and utilization; combat crew selection and training; Non-Commissioned Officer (NCO) selection and assignment; individual job-relevant training; performance-based individual skill qualification testing; individual extension training systems; criteria for assignment of women to units; methods to overcome constraints on utilization of women; demonstration projects to assess the effectiveness of new managerial and leadership training on unit and organizational performance.

F. RELATED ACTIVITIES: Through the Department of Defense this work is coordinated with related work in the Navy under Program Elements 6.27.63N, Naval Personnel Support Technology, and 6.37.07N, Navy Manpower Control System Development, and in the Air Force under Program Element 6.27.03F, Personnel Utilization Technology. Related Army Program Elements are 6.27.17A, Army Personnel and Manpower Technology, and 6.37.44.A, Army Contemporary Issue Development. Inter-service coordination is effected through annual tri-service development of Department of Defense Technology Coordinating Papers, and tri-service committees in such areas as education and training, manpower, women and organizational effectiveness.

G. WORK PERFORMED BY: Contractors include: General Research Corporation, McLean, VA; Human Resources Research Organization, Alexandria, VA; Kinton, Inc., Alexandria, VA; Systems Development Corporation, Santa Monica, CA; Richard A. Gibboney Associates, Inc., Kensington, MD; University City Science Center, Philadelphia, PA; Personnel Decisions Research, Inc., Minneapolis, MN; Advanced Research Resources, Inc., Bethesda, MD; American Institutes for Research, Palo Alto, CA. Other contracts will total $650,000. In-house research is performed by the US Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Advanced development products include: Army standards for the new Armed Services Vocational Aptitude Battery (ASVAB) for selecting personnel; factors for selecting recruiters to improve recruiter productivity and to prevent recruiter malpractice through over-zealous intent to produce; updated factors and incentives that motivate individuals to join the Army and Reserves to improve recruitment and retention of quality enlisted personnel; Military Aptitude Predictor (MAP) for screening out unsuitable soldiers to prevent costly first-term enlisted personnel attrition due to failure to adjust to demands of Army life; reenlistment motivations/incentives; techniques for Regular Army officer selection and assignment; standardized training and Skill Qualification Test (SQT) systems for use in units; self-instructional materials for preparing SQT's; effects of varying percentages of women on unit performance; peer rating techniques for Reserve Officer Training Corps (ROTC) cadets and junior officers.

2. FY 1978 Program: Advanced development efforts are being conducted to: improve the enlisted force through development of a new type test for screening out applicants unsuited for Army life; validate the Armed Services Vocational Aptitude Battery

(ASVAB) and develop new test composites for Army Military Occupational Specialty (MOS) assignment; continue development of new interactive and cost-effective training techniques for Reserve Officer Training Corps (ROTC); develop machine-scorable functional literacy test for Army jobs; revise the Motor Vehicle Driver Selection Test; develop improved methods for selecting productive recruiters; develop instruments for selecting forward observer (FO) personnel; develop skill qualification training requirements for Remotely Piloted Vehicle (RPV) operators; identify characteristics that predict success of Senior Noncommissioned Officers (NCO); study transfer and retention of Chaparral missile crewmen skills from school to unit; develop refresher training packages for combat crewmen skills; develop non-resident training packages and system for Active Army and Reserves; develop training and testing program for maintenance units; develop performance-based individual training system for the Infantry; develop tests for selecting and assigning soldiers to tank crew positions; evaluation of the cost-effectiveness of the Army's individualized Training Extension Course (TEC); develop a General Diagnostic Survey (GDS) to identify a broad range of problems affecting performance of organizations; conduct evaluations of new leadership and managerial techniques in the Army.

3. FY 1979 Planned Program: Advanced development will continue FY 78 efforts as follows: investigate new techniques and content for ASVAB; continue the evaluation of TEC cost-effectiveness; investigate performance of mixed-sex units; development of alternative organizational diagnostic methodologies; long-term evaluations of new managerial and leadership techniques; isolation of selection factors for Forward Observer and Remotely Piloted Vehicles personnel; validation of revised NCO selection tests. New efforts include: validation of new recruiter selection procedures; reenlistment forecasting model; evaluation of experimental recruiter reward system; evaluation of comparative performance of ROTC scholarship recipients; evaluation of effectiveness of ROTC programs. Increased FY 79 funding provides for advanced development of prototype performance-based training and evaluation packages for combat arms units as follows: (a) individual extension training systems for all combat arms and Operations and Intelligence specialists; (b) analytical tools for identifying and developing critical Armor performance skills and tasks; and (c) a model to determine what, when and where to train for Air Defense and Artillery tasks. Increases also provide for development of additional managerial and leadership techniques to expand scope and types of unit and organizational problems that can be addressed; development and validation of new electronic maintenance skills training program; development of cost-effective assessment methods for organizational demonstration projects; overcoming constraints on utilization of women.

4. FY 1980 Planned Program: Advanced development efforts will be conducted to continue work on recruiting and reenlistment systems for Active Army and Reserve Components; to develop leadership training program evaluation for application to Officer Candidate School (OCS), US Military Academy, Officer Basic Course, and Officer Advanced Course; to validate and evaluate non-resident job training packages; to continue research to improve quality of Skill Qualification Tests (SQT's); to evaluate new Armor crew selection and training procedures; to evaluate Training Information Feedback System; to continue work on effects of assigning women to units and performance of such units under extended operational conditions; to continue work on acquisition, retention, and utilization of female officer and enlisted personnel; to continue work on utility of various leadership and managerial intervention techniques and diagnostic methods, including development of self-instructional materials and user documentation; evaluation of long-term effects in organizational effectiveness demonstration projects.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.37.32.A

Title: Combat Medical Materiel

DoD Mission Area: # 221 - Soldier Support/ Survivability

Budget Activity: # 2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING) ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion		Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	88	94	106	113	Cont	uing	Not Applicable
AE34	Combat Medical Materiel	88	94	106	113	Continuing		Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides research input into medical support of combat field operations to insure a reliable and efficient casualty treatment system. Efforts are made to improve medical support through improved sterilization of supplies, whole body x-ray, purified water production, insect detection and control, support of clinical laboratory determinations, dental equipment, eye examination, field sanitation and patient handling.

C. BASIS FOR FY 1979 RDTE REQUEST: Requested funds provide for the prototype field medical human body diagnostic examination and recording system; a clinical analysis system for field use will continue to be developed; a blood screening device, which provides an accurate method of counting red/white blood cells will be built; equipment for providing rapid evaluation of the derangement of various constituents in body fluids of casualties will be under development and water-water reuse of mobile field hospitals will undergo further research and development.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Greater tactical flexibility in modern warfare and new weapon developments have increased the problems and complexity of diagnosing and treating large numbers of combat injuries. This program is an aggressive research effort to develop new and improved medical field equipment for future incorporation into the casualty treatment system to meet projected modern warfare requirements.

F. RELATED ACTIVITIES: Related studies and work are performed under program elements/projects 6.27.38.A/AA38, Combat Medical Materiel, and 6.47.17.A/AA32, Combat Medical Materiel.

G. WORK PERFORMED BY: US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD.

Element: # 6.[illegible] Title: Combat Medical Materiel

DoD Mission Area: # 221 - Soldier Support/ Survivability

Budget Activity: # 2 - Advanced Technology Development

II. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Fabricated field sterilization prototypes were operationally tested and evaluated to determine reliability, maintainability, and durability. Prototypes of the environmental protection container for medical supplies were operationally tested in Alaska during Joint Training Exercise Jack Frost 1977. Design and functional modifications were made based on results of the test. Advanced developmental prototype fabrication, development testing and operational testing for a field dental chair and related equipment were accomplished.

2. FY 1978 Program: Advanced prototypes of new emergency sterilizers are being fabricated. A hardened prototype of the Flying Spot X-Ray is being built and made available for operational testing contingent upon satisfactory test results and the effort is being continued into engineering development. Prototypes of the environmental protection container are scheduled for retesting in a winter exercise in the second quarter of 1978.

3. FY 1979 Planned Program: Elements of the field medical human body diagnostic examination and recording system will move to advanced development with the objective of insuring a more accurate and rapid means of diagnosis and of reducing personnel requirements. Development will continue on clinical analysis systems for field use. Equipment will provide for rapid evaluation of the derangement of various constituents in body fluids of casualties. Improved survival rate of injured soldiers and rapid return to duty will be a natural result of this improved and accelerated treatment. Construction of selective blood screening device prototypes will provide an accurate and rapid method of counting red/white blood cells and platelets. The funding increase from FY 78 to FY 79 will offset the expected inflationary change.

4. FY 1980 Planned Program: Advanced prototypes of a waste water reuse system for mobile field hospitals will be fabricated and tested. A remote communications system with monitoring centers for use in isolated medical treatment areas will be developed. Other ongoing programs will be continued.

5. Program to Completion: This is a continuing program.

FY 1979 CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.38.A
DoD Mission Area: #222 - Training and Personnel Technology

Title: Non-Systems Training Devices (NSTD) Development
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2844	5160	5300	9700	Continuing	Not Applicable
A115	NSTD Infantry	2844	1094	1025	1000	Continuing	Not Applicable
A224	NSTD Armor/Anti-Armor	0	4066	3375	3000	Continuing	Not Applicable
A225	NSTD Artillery/Air Defense/Engineer	0	0	600	2500	Continuing	Not Applicable
A226	NSTD Combined Arms	0	0	300	3200	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army has a critical need to provide cost effective, realistic training without expending gross quantities of live ammunition and wearing out sophisticated, expensive combat equipment. Simulation technology provides an alternative. This program objective is to develop realistic and effective training devices and simulators to assist both individuals and units to attain and maintain a high degree of proficiency and combat readiness through high fidelity simulation of modern weapons and the modern battlefield environment. Program provides for fabrication and testing of breadboard prototypes which will provide the necessary information and risk assurance prior to entry into Engineering Development phase.

C. BASIS FOR FY 1979 RDTE REQUEST: Complete the advanced development of armor anti-armor systems begun previously - Tank Weapons Gunnery Simulation System and Armor Remoted Target System. Continue the efforts on the Armor Full Crew Interaction Simulator. These three developments will provide an integrated coordinated capability to train combat manuever forces in armor tactics and employment without seriously degrading the readiness posture of the units in the field. Additionally, efforts will be initiated in simulators for indirect fire weapons, electronic warfare devices and other area threat type weapons - nuclear, biological and chemical.

Program Element: #6.37.38.A
DoD Mission Area: #222 - Training and Personnel Technology

Title: Non-Systems Training Devices (NSTD) Development
Budget Activity: #2 - Advanced Technology Development

D. OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
Military Construction, Army*	0	0	805	0	0	805

* Construction of facilities required for the Armor Full Crew Interaction Simulator (AFCIS) - research facility at Fort Knox, Kentucky.

E. DETAILED BACKGROUND AND DESCRIPTION: The Army's Non-Systems Training Devices development programs have traditionally been financed exclusively with Category 6.4 funds (Engineering Development). Such a system was sufficient to support a training philosophy which embraced the use of simulation in institutions and the use of operational equipment as the unit's training support mechanism by using state-of-the-art technology. Escalating resource costs and diminishing training budgets combine to mitigate a change in that philosophy. The Army has, therefore, embarked on a major initiative to introduce simulation devices into the unit environment. The heart of that initiative is a comprehensive Advanced Development program which allows for logical progression from Exploratory Development into Engineering Development. Program provides for fabrication and testing of experimental prototype (breadboard) training devices which provide the necessary information and risk assurance prior to entry into Engineering Design phase.

F. RELATED ACTIVITIES: The program is closely coordinated with the other services, Joint Service Technical Coordinating Group, Training and Personnel Technology Conferences, Topical Reviews, joint use of resources at the Naval Training Equipment Center, and worldwide staffing of training equipment/devices requirements. Related program elements are PE 6.27.27.A, Non-Systems Training Devices Technology; 6.27.22.A, Army Training Technology; 6.47.13.A, Non-Systems Training Devices Engineering; 6.37.31.F, Innovation in Education and Training; 6.32.27.F, Advanced Simulation Technology; 6.37.20.H, Education and Training. Starting in FY 1978, this program element was restructured along more functional areas with funding being applied during FY 1978 and FY 1979 as shown in project listing above.

G. WORK PERFORMED BY: Primary contractors: International Laser Systems Incorporated, Orlando, FL and Sperry Rand Corporation, Huntsville, AL. All other programs are currently scheduled to be released on a competitive basis. Potential or anticipated bidders include: Singer Co., Silver Springs, MD; BBN Corp., Monterey, CA; Xerox Electro-Optical Systems, Inc., Pasadena, CA; Detroit Bullet Trap, Detroit, MI; ARA Electro-Mechanical Systems Corp., Pinellas Park, FL, American Airlines, Fort Worth, TX; Hughes Aircraft Co., Fullerton, CA; and General Electronic Co., Daytona Beach, FL. The above list does not represent a complete list of contractors that may bid for approximately $6.3M. In-house developing organizations responsible for the program are the Naval Training Equipment Center, Orlando, FL, and the US Army Development and Readiness Command subordinate agencies as tasked by the Project Manager for Training Devices (PM TRADE), Orlando, FL.

Program Element: #6.37.38.A
DoD Mission Area: #222 - Training and Personnel Technology

Title: Non-Systems Training Devices (NSTD) Development
Budget Activity: #2 - Advanced Technology Development

H. PROGRAM ACCOMPLISHMENTS AND FUTURE ACCOMPLISHMENTS:

1. FY 1977 and Prior Accomplishments: Continued prototype development for the Infantry Remoted Target System (IRETS) and the Marksmanship Gunnery Laser Device (MAGLAD) to provide realistic and cost effective Infantry training. Program element was initiated during FY 1976.

2. FY 1978 Program: Complete Advanced Development (AD), to include Development Tests I/Operational Test I (DT I/OT I) tests, for the IRETS and MAGLAD prototypes. Programs to proceed into Engineering Development on an accelerated basis. Initiate AD effort for the following programs critically needed for Armor/Anti-Armor training: Armor Remoted Target System (ARETS) to provide the capability to simulate realistic threat environments; the Tank Weapons Gunnery Simulation System (TWGSS) to provide tank gunnery training without the use of Service ammunition and real estate constraints; and the Armor Full Crew Interaction Simulator (AFCIS) research facility.

3. FY 1979 Planned Program: Complete AD effort, to include DT I/OT I testing, for TWGSS and ARETS programs initiated in prior years. Continue major development effort for the AFCIS research facility. Initiate development effort on the Indirect Area Fire Simulator, Electronic Warfare (EW) Simulator, and Nuclear/Biological/Chemical (NBC) Simulators which will provide realistic training to units in coping with these threats in combat environments. Training in these critical areas is considered very inadequate at this time. The US Army does not possess the means to conduct realistic and effective training to prepare our soldiers to cope with these environments. The programs initiated during FY 1979 will provide training capability not previously available.

4. FY 1980 Planned Program: Complete AD effort for the Indirect Area Fire Simulator, EW and NBC simulator and the Armor Full Crew Interaction Simulator Research Facility. Initiate development effort for realistic maintenance training devices for all labor/maintenance intensive equipment (this area is considered high rate of return on investment). Initiate development for a realistic engineer equipment simulator.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.41.A
DoD Mission Area: #224 - Environmental Sciences

Title: Meteorological Equipments Development
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1200	1137	590	1200	Continuing	Not Applicable
D533	Meteorological Equipment Development	1200	0	0	0	None	Not Applicable
D158	Meteorological Equipment & Systems	0	1137	590	1200	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Conduct advanced development (AD) on meteorological equipment required by the Field Army in support of combat operations. The Field Artillery urgently requires a highly mobile, lightweight, automated data processing and nonradiating meteorological data acquisition system to assure maximum combat effectiveness of the Field Artillery on the modern day battlefield. The meteorological data is critical to artillery fire direction calculators. Lack of this data can cause artillery impact errors of up to 500 meters. Also, a means of providing weather information from inaccessible areas is required for Intelligence in support of combat operations.

C. BASIS FOR FY 1979 RDTE REQUEST: The AD of the Meteorological Station, Automatic, AN/TMQ-30, will be initiated to provide real time meteorological data from remote areas in support of airborne, artillery and aviation operations. A contract will be awarded for AD models of the AN/TMQ-30.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to provide an Atmospheric Sciences Advanced Development program for support of combat operations. Items currently included in this program area: (1) The Field Artillery Meteorological Acquisition System (FAMAS) required by the Artillery Center and School, US Army Training and Doctrine Command,

and identified in the Battle King Study; (2) the Meteorological Station, Automatic, AN/TMQ-30, formerly Remote Automatic Weather Station (RAWS), required by the Intelligence Center and School, US Army Training and Doctrine Command (TRADOC), and identified as a high priority in the TRADOC Tactical Environmental Support System Study. The 6.3 development of the FAMAS was initiated in FY 1977 to provide Army Artillery Battalions with timely and accurate meteorological data. The FAMAS will be highly mobile, lightweight, automated data processing and nonradiating meteorological data acquisition system to increase the accuracy of Artillery fire. The FAMAS is being developed with the capability of being deployed utilizing Navigation Aid (NAVAID) and/or Radio Direction Finding (RDF) antennae with the data processing and communications being common to both antenna systems. The present system utilized for gathering meteorological data is obsolete and does not possess the necessary mobility to be employed in the forward area of the battlefield. It uses manual data reduction techniques which requires more personnel and time to process the data. The Meteorological Station Automatic, AN/TMQ-30, is being developed to provide real time meteorological data from remote areas in support of airborne, artillery and aviation operations, smoke and chemical agency employment, surveillance and target acquisition. Data collected will be wind speed and direction, temperature, humidity (dew point) and pressure. Deployment of the remote station will be hand emplaced initially with air or ballistically emplaced sensors a future consideration. Presently, commanders and staff cannot obtain current localized weather information from either remote friendly or enemy-held areas with sufficient accuracy or detail to permit utilizing meteorology positively as a combat tool. The AN/TMQ-30 will provide near real time weather data for tactical operations and long range military planning.

F. RELATED ACTIVITIES: Program Element (PE) 6.11.02.A, Project B53A, Atmospheric Sciences, PE 6.21.11.A, Project AH71, Atmospheric Investigations; and PE 6.47.26.A, Meteorological Equipment and Systems. Requirements are coordinated with the Army-Air Weather Service Meteorological Equipment Coordination Committee. As a result of Committee Coordination, equipments are being developed to meet Army and Air Force requirements. Coordination on Meteorological Equipment Development with NATO allies is accomplished through participation in Panel XII (Meteorology), NATO Army Armaments Group. Several NATO nations have expressed an interest in purchasing items of US equipment currently under development. Coordination with the National Weather Service and nonmilitary organizations developing meteorological equipment for civilian use is accomplished through the Office of the Under Secretary of Defense for Research and Engineering (OUSDRE) participation on the Interdepartmental Committee for Applied Meteorological Research (ICAMR), and through the Annual Symposium on Meteorological Observations and Instrumentation, sponsored by the American Meteorological Society.

G. WORK PERFORMED BY: Approximately fifty percent of the work is accomplished in-house by the Atmospheric Sciences Laboratory (ASL), White Sands Missile Range (WSMR), NM, and Combat Surveillance and Target Acquisition Laboratory (CSTAL), Fort Monmouth, NJ. Contracts totaling approximately 1 million will be placed with successful bidders.

Program Element: #6.37.41.A
DoD Mission Area: #224 - Environmental Sciences

Title: Meteorological Equipments Development
Budget Activity: #2 - Advanced Technology Development

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: An exploratory model of Field Army Meteorological Acquisition System (FAMAS) was fabricated and demonstrated to the user community. Based on the user urgency for the FAMAS, an expedited development schedule, to include Integrated Technical Documentation and Training (ITDT), was prepared and staffed in both the US Army Materiel Development and Readiness Command (DARCOM), and the US Army Training and Doctrine Command (TRADOC). A draft Required Operational Capability (ROC) was prepared and submitted. A procurement package was prepared and submitted.

2. FY 1978 Program: A contract will be awarded to the successful bidder for advanced development (AD) models of FAMAS (1st year increment) and the development plan will be updated. In order to expedite the fielding of FAMAS, the AD contract will be converted to an engineering development (ED) contract in FY 1979.

3. FY 1979 Planned Program: The AD of the Meteorlogical Station, Automatic, AN/TMQ-30, will be initiated. A contract will be awarded to the successful bidder for AD models of the AN/TMQ-30. The development plan will be updated and Development Test/Operational Test I Plan will be prepared and coordinated. The funding level was decreased by $547 thousand from FY 1978 because FAMAS will have entered ED.

4. FY 1980 Planned Program: Acceptance tests will be conducted by the contractor on the AD models of the AN/TMQ-30. Development Test/Operational Test I will be conducted. Test results will be received and a validation In-Process Review conducted. A draft ROC will be prepared and submitted.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.42.A
DoD Mission Area: #211 - Electron Devices

Title: Advanced Electronic Devices
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	1227	700	1350	Continuing	Not Applicable
DF3201	Beam, Plasma, Display and Transmitter Devices and Subsystems	0	673	375	410	Continuing	Not Applicable
DF3202	Semiconductor Devices and Integrated Circuits	0	334	190	820	Continuing	Not Applicable
DF3203	Signal Processing Devices	0	220	135	120	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The program provides advanced development models of electronic components, assemblies and subsystems for application in military systems. The mission need of the program is to increase the combat readiness of the Army by extending successes attained in exploratory development into advanced development to correct specific deficiencies in fielded Electronic Warfare, Radar, and Communications Systems. The approach includes the development of sufficient numbers of device models/modules to determine reliability, performance, reproducibility with major emphasis on greater commonality of application and lower life cycle costs.

C. BASIS FOR FY 1979 RDTE REQUEST: Continue development of an affordable and reliable high power traveling wave tube for the Artillery Locating Radar, AN/TPQ-37. Continue development of low cost, lightweight expendable jammer. Continue development of Standard Electronic Modules to simplify diagnosis, to minimize the number of parts/components and to provide parts commonality and interchangeability of electronic equipment. Complete development of a tactical miniature crystal oscillator for the Global Positioning System.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This program is a diversified advanced development program in electronic devices, components, assemblies and subsystems for application in military systems. Research and exploratory development programs that have successfully demonstrated feasibility will be carried into advanced development to meet user needs in an efficient and

timely fashion and to provide a stimulation for industry where necessary. Emphasis will be placed on insuring performance capability, while stressing reliability, cost-effectiveness, and modular packaging features. The approaches pursued include trade-off studies and analyses of component technology and module interface problems based on defined user needs. This will determine the optimum device and subsystem characteristics that will meet specific requirements for Radar, Secure Communication and Electronic Warfare systems.

F. RELATED ACTIVITIES: Coordination is achieved with other government agencies through participation in the activities of the Department of Defense Advisory Group on Electron Devices. Inter-service coordination and program cooperation are also directly derived from joint preparation of the Technology Coordinating Paper on Electronics which assess the technical program, goals and potential pay-off from the tri-Service total investment of electronics technology base funds. Program Element 6.27.05.A, Electronics and Electron Devices, provides the Exploratory Development effort for the program.

G. WORK PERFORMED BY: The US Army Electronics Research and Development Command, Fort Monmouth, NJ provides the in-house laboratory effort which represents approximately 10 percent of the program funds requirement. Four contracts totaling $630 thousand will be awarded in the near future.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Not Applicable.

2. FY 1978 Program: The high power final output traveling wave tube for the Artillery Locating Radar, AN/TPQ-37, will be ruggedized for use in a tactical environment and have its self-protection circuitry improved so that a 5000 hour tube life will be obtained and a 500 hour Mean Time Between Failure of the transmitter realized. Present system development and redesign of the advanced development transmitter has resulted in a laboratory environment transmitter Mean Time Between Failure of 190 hours whereas a field use Mean Time Between Failure of greater than 450 hours is desired. The present version of an active Infrared jammer, AN/ALQ-144, is capable of protecting utility, scout and attack helicopters against current threat missiles. Advanced Infrared heat seeking missiles will operate at longer wavelengths and protection of aircraft against these threats requires a higher Infrared source operating temperature than that of the current silicon carbide source. A graphite source currently being developed for the AN/ALQ-144 offers the lowest risk approach to obtaining increased long wavelength output. The electronic interface will be designed and integrated to provide several selectable operating voltages for the generating of Infrared sources capable of operating with the available aircraft power. Low cost (less than $1000) jammer packages capable of being delivered by remotely piloted vehicles, mortars and shells are required to neutralize enemy fire control and aircraft tracking radars. Improvements to a mini-traveling wave tube package will be made to increase the overall efficiency from 20 to 25 percent, reduce the tube cost to $500 and reduce the size and weight of the total package. Available Standard Modules will be applied to a select Army equipment to demonstrate the potential reliability and life cost advantages resultant from previous paper studies; i.e., 6-12 months reduction in development lead time; 20-50 percent increase in equipment Mean Time Between Failure and a 20-25 percent reduction in life cycle cost. Advanced development of a 1 cubic inch crystal oscillator, having $2x10^{-8}$/year overall stability and

less than 250 milliwatt power consumption will be undertaken to develop extremely small, low power, highly stable reference oscillators required for use in the Global Positioning System/Navigation by Stationary Relay (NAVSTAR) manpack receiver equipments. The increasing quantity and complexity of communications traffic as well as the need for operating in a nuclear environment has created a need for significantly greater transmission efficiency and nuclear hardening of wire, cable and interconnecting devices. The advanced development of Fiber Optic cable assemblies to replace the standard CX-4566 conventional metallic conductor cable for local distribution systems will be made available for field evaluation and testing. The design of the cable will be optimized to provide minimum size, weight, and cost consistent with the necessary transmission properties and the flexibility, ruggedness, Electromagnetic Pulse immunity and environment resistance to survive under tactical field conditions. Future Signal Intelligence Systems for signal detection, signature analysis, and threat identification require extremely compact and low power consuming circuitry. Experimental devices performing the discrete Fourier Transform using charge coupled devices will be designed and advanced development models fabricated to meet full military requirements.

3. FY 1979 Planned Program: The ruggedization and improvement of the high power final output Traveling Wave Tube for the Artillery Locating Radar, AN/TPQ-37, will be continued. The redesign of the tube with a self-protect isolated anode will be evaluated to determine the effectiveness of the arc protection circuit and possible removal of the crow-bar circuit. The removal of the crow-bar reduces the number of active components which affects the overall Mean Time Between Failure. Interim model tubes will be constructed for performance evaluation and the data used to finalize the tube design to obtain an operational life of 5000 hours while meeting system electrical and environmental requirements. The advanced development of the low cost, mini-Traveling Wave Tube jammer package capable of being delivered by Remotely Piloted Vehicles, mortars and shells will be continued. Life and reliability will be evaluated to assure that no interface problems exist. Dormant shelf life will be evaluated to assure that turn-on after shelf life is not a problem. The Standard Electronic Module (SEM) program will be continued by developing SEMs for Army test, manpack, computer, and avionics equipment. One equipment from each of the above classes will be selected and a prototype will be designed and fabricated using the previously developed SEMs. Advanced development of the tactical miniature crystal oscillator equipment will be concluded with major emphasis on packaging and finalization of the thermal and mechanical design of the unit. Fifty units will be fabricated, tested and delivered for use by the Global Positioning System/Navigation by Stationary Relay (GPS/NAVSTAR) contractors. The decrease in FY 1979 funds is due to reduced contractual effort.

4. FY 1980 Planned Program: The Traveling Wave Tube program for the Artillery Locating Radar, AN/TPQ-37, will be concluded by having tubes undergo detailed electrical, mechanical and environmental tests to obtain data to insure reliable operation in the field with a 5000 hour tube life. The development of a mini-Traveling Wave Tube transmitter package will be completed and a ruggedized package made available for the lightweight Remotely Piloted Vehicle borne expendable jammer. The Fiber Optic cable assemblies for local distribution systems program will be completed and specific models will be incorporated in selected field tests to determine operational feasibility of Fiber Optic data systems. At the present time, US forces have a limited capability to determine range to targets and terrain features, however, these devices are too heavy and voluminous. This limitation seriously affects the ability to place timely and effective fires on known enemy locations and targets of opportunity. A program will be started to provide for a compact nanosecond pulser for laser target designators/rangefinders for portable systems. This

refinement program will reduce the pulser's weight from 25 to 3 kilograms and volume from 3600 to 500 cubic centimeters. A low cost capability for detecting and recognizing small targets through smoke, adverse weather, foilage and camouflage at ranges up to is likewise required by the Army. Millimeter wave device development is greatly being accelerated because of its ability to penetrate smoke and fog and a new concept, dielectric waveguides, offers promise for low cost. A program will be started to evaluate low cost dielectric waveguide transmitters and ruggedize them to meet military requirements. Solid state combiners capable of 1-10 watts at 94 gigahertz are to be developed for high resolution surveillance radars and target designators. A lightweight, 1.0 kilowatt peak power, 3.2 millimeter wave tube will be developed with weight reductions of 45.4 to 6.8 kilograms and volume reductions of 6600 to 2080 cubic centimeters. The tempo of modern battle demands timely information from all sources, rapidly processed and made available to the commander. The feasibility of using charge coupled devices for radar analog signal processing has been demonstrated. Procurement specifications, qualification test procedures, and performance limits will be developed for the Fourier Transform charge coupled devices used in signal detection, signal analysis, and threat analysis, and future Signal Intelligence Systems.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.43.A
DoD Mission Area: #222 - Training and Personnel Technology

Title: Training and Utilization in Military Systems
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5252	5600	7848	10389	Continuing	Not Applicable
A771	Systems Embedded Training Development	820	920	920	1184	Continuing	Not Applicable
A772	Aircrew Performance in Tactical Environment	899	1320	1309	1997	Continuing	Not Applicable
A773	Combat Unit Training	2132	1380	1980	2011	Continuing	Not Applicable
A774	Man-Machine Integrated Battlefield Systems	868	750	864	1056	Continuing	Not Applicable
A775	Human Performance in Field Assessment	533	805	774	970	Continuing	Not Applicable
A780	Training Development for Battlefield Effectiveness	0	240	1401	1871	Continuing	Not Applicable
A783	On-the-Job Individual Training Technology	0	185	600	1300	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Army combat readiness is vital to national security. To improve and maintain readiness, the Army needs advanced development on: automated training and training devices for individuals and units; training and simulation use for helicopter flight crews; realistic engagement simulation training for combat and support units; techniques and procedures for man-machine interface in integrated battlefield systems; techniques and methods for field assessment of weapons systems; transfer of training technology to users; and training systems for retention of critical military skills.

C. BASIS FOR FY 1979 RDTE REQUEST: The Army's Training and Doctrine Command is introducing radical changes for achieving combat readiness by decentralizing and improving unit training and evaluation while reducing the institutional training base. Projects A780 and A783 support these changes through development of a technology transfer delivery system for individual and unit training in the field. Project A772 directs technology development toward utilization of new Army helicopter simulators and toward maintenance of helicopter crew proficiency operationally. Other activities: Operating procedures for existing and newly developing systems; cost-effective training methods based on evolving computer training technology; assessments and techniques for utilization of simulators and simulations to induce realism and effectiveness in combat training, reduce use of actual systems, fuels and ammunitions, and reduce hazards associated with systems' use; training techniques and systems to insure retention of critical skills in operational units.

D. OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.37.43.A
DoD Mission Area: #222 - Training and Personnel Technology

Title: Training and Utilization in Military Systems
Budget Activity: #2 - Advanced Technology Development

E. DETAILED BACKGROUND AND DESCRIPTION: Systems Embedded Training Development provides cost-effective packages using actual system hardware of complex computerized tactical systems to self-train users in system operation. Aircrew Performance in Tactical Environment addresses training for helicopter flight crews in nap-of-the-earth (NOE) piloting and navigation, and use of flight simulators and flight proficiency maintenance in operational units. Combat Unit Training integrates realistic two-sided tactical engagement simulation training into Army Training and Evaluation Programs, (ARTEP). Man-machine Integrated Battlefield Systems upgrades command and control capability through improved battlefield information development and display, staff aids to battle management, and operating procedures in continuous operations. Human Performance in Field Assessment develops methods for human factors evaluations of weapons systems, and provides field assessment of new training, doctrine and combat developments from new engagement simulation techniques. Training Development for Battlefield Effectiveness and On-the-job Individual Training Technology provide implementation methodology and guidance for transferring new training developments to individuals and field units.

F. RELATED ACTIVITIES: Program Elements 6.37.51.F, Training and Education Innovations; 6.37.20.N, Education and Training; 6.27.22.A, Army Training Technology; 6.37.38.A, Non-systems Training Devices Development. Interservice coordination is effected through annual and monthly tri-service technical coordination reviews, budget and apportionment reviews under Department of Defense (DoD) auspices and participation in tri-service development of DoD Technology Coordinating Papers, and tri-service committees in such areas as educational technology, training simulation, human factors in operational testing, and aviation crew performance.

G. WORK PERFORMED BY: Human Sciences Research, McLean, VA; Human Resources Research Organization, Killeen, TX; Systems Development Corporation, Santa Monica, CA; Manned Systems Sciences, Dothan, AL; Litton Systems, Columbus, GA. Other contracts will total about $2.5 million. US Army Research Institute for the Behavioral & Social Sciences, Alexandria, VA (in-house).

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Feasibility of using Army tactical data systems to train users in "how to use the systems" has been demonstrated, has already resulted in a saving of over $10 million just for the Tactical Fire Control System (TACFIRE). A self-paced and self-instructional Map Interpretation and Terrain Analysis Course for nap-of-the-earth helicopter navigation reducing errors by 33 percent has been developed and introduced at the Army Aviation Center and for Army-wide use. An effective training program for basic rifle marksmanship reducing annual ammunition costs by $6.9 million has been developed and introduced. A prototype forward observer training simulator has been found effective as a partial substitute for live-fire training with potential annual ammunition cost savings of $650 thousand. A realistic and effective combat engagement simulation technique (REALTRAIN) for training small infantry, armor and combined arms units has been developed and introduced Army-wide. The Combined Arms Tactical Training Simulator, using a computer-driven battalion level scenario, has yielded significant improvement in training commander and staff in planning, understanding and executing the battle. Development of mini-tank range simulation for training tank gunnery skills has reduced main gun range firing requirements. Benefits derived from this development reduced ammunition costs, tank transportation costs, and provided fuel savings while maintaining peak efficiency at homebased installations.

2. FY 1978 Program: Implementation of a handbook to assist operational users in developing simulation and training equipment requirements and qualitative specifications prior to weapons systems development. Model for training problem solving strategies for use in on-duty educational programs and for Skill Qualification Test training. Demonstration of a microprocessor-based battle

simulation to enable users to conduct more cost-effective command post and field training exercises. Expansion of helicopter pilot Map Interpretation and Terrain Analysis Course materials to include a variety of locations, terrain, and seasonal variations. Objectives for training pilots in air-to-air combat tactics and in maintaining proficiency in helicopter aerial defense. Objective performance grading system and handbook for flight simulators. Crew simulator training requirements and performance standards for M60A3 tank personnel. Operational implementation of REALTRAIN techniques for armored cavalry and artillery units. Validation of technology for REALTRAIN air-ground engagement simulation. Standard operating procedures for the Tactical Operations System and improved computer aids for tactical information management and decision making. Development and field testing of night navigation aids and procedures. Design of sensor system acquisition and processing model incorporating specific mission requirements, time constraints, environmental conditions and precision and reliability needs. Conduct of human factors and training of operational systems such as: Enemy position locating systems, tank mounted thermal night sights and target identification by helicopter crews. Development and distribution for operational use of updated and extended Army Training and Evaluation Program evaluation guidebook.

3. FY 1979 Planned Program: Field validation of a unique computer-managed instruction system with across-the-board Army applications and usable without modification on any type of Army computer. Development and introduction of improved Tactical Fire Control System proficiency maintenance package to enable users to receive training in more skills to greater depths. Conduct of field evaluation of a computer-based instruction system for administering Technical Extension Course materials. Performance-based automated student pilot selection procedure using the (UH-1) training simulator. Specifications of minimum weather conditions under which nap-of-the-earth flight can take place. Design of unit training programs for Skill Qualification Test training for combat and combat support military occupational specialities. Establishment of guidelines for improved tank platoon gunnery. Improved training program for range estimation for infantry weapons supplemented by selected ranging aids. Implementation of threat-oriented M16A1 rifle marksmanship programs of instruction. Alpha-numeric and graphic movement analysis aids for use of intelligence and operations staffs. Self-instructional materials on how to conduct large-scale evaluations of job performance programs in operational units. Specifications of training requirements and standards for battalion-level combat units in United States Army, Europe. Development and delivery to users of effectiveness measures for tank crews. Development of self-instructional programs for training managers and supervisors. Funding increase will implement Defense Science Board Task Force on Training Technol recommendations for closer working ties between researcher and major user and for advanced efforts on crew, group and team trai ng.

4. FY 1980 Planned Program: Demonstration at a field site of Computer Training System adapted to individual requirements using transportable software package for training electronic trouble-shooting skills. Cost-effective method for tank unit training. Field validation of map reading courseware utilizing computer graphics. Differential assignment program for Initial Entry Rotary Wing pilot training directed toward eventual assignment to specialized attack and scout combat/tactical or utility/cargo-lift training. Updating of Army-wide norms for unit effectiveness/readiness. Guidelines for depicting minimum essential unit information and terrain characteristics for use with simplified maps, map enhancement techniques, and new discriminable symbol sets. Application of simulation technology to self-contained instructional modules on doctrine and operations for Tactical Operations System. Management methods for large scale training programs such as Integrated Technical Documentation and Training for operational and maintenance jobs. Guide for preparing tests to evaluate on-the-job training for infantry noncommissioned officers. Integrated family of battle simulations for diagnosis, remediation and enrichment of command group/staff performance within and between echelons.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.44.A
DoD Mission Area: #222 - Training and Personnel Technology

Title: Army Contemporary Issue Development
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	209	485	450	500	Continuing	Not Applicable
A769	Army Contemporary Issue Development	209	485	450	500	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army has requirements for programs to enhance Equal Opportunity for all races, minorities and women serving in the Volunteer Army. In addition, it needs an effective monitoring system to determine how various personnel management policies and factors affect the success of the Army in obtaining and retaining the appropriate quantity and quality of volunteers. This program supports advanced development efforts to meet these requirements through work to develop techniques for training and evaluating programs for managing and reducing personnel turnover and dissension, to implement strategies for effective utilization of equal opportunity programs developed, and develop computerized systems for monitoring factors critically affecting personnel morale and retention.

C. BASIS FOR 1979 RDTE REQUEST: Continuing advanced development efforts necessary to investigate the effect of critical personnel and equal opportunity programs on the operational effectiveness of individuals and units, to develop strategies to further institutionalize programs developed to reduce personnel turnover and dissension, and to develop improved personnel measurement instruments to support the Army's Equal Opportunity Training and Evaluation Programs.

D. OTHER APPROPRIATION FUNDS: Not Applicable

E. DETAILED BACKGROUND AND DESCRIPTION: Advanced development work in this program applies technology base efforts and methodological developments of Program Element 6.27.17.A, Army Personnel and Manpower Technology, to programs concerned with improving soldier productivity. The specific areas addressed provide for direct implementation of personnel management and equal opportunity programs at the field unit level. This advanced development program provides the sole vehicle for validation and implementation of Department of Army sponsored programs in the areas of race and ethnic relations and equal opportunity programs.

F. RELATED ACTIVITIES:

None.

Program Element: #6.37.44.A
DoD Mission Area: #222 - Training and Personnel Technology

Title: Army Contemporary Issue Development
Budget Activity: #2 - Advanced Technology Development

G. WORK PERFORMED BY: Human Sciences Research, Inc., McLean, VA; in-house by the US Army Research Institute, Alexandria, VA.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 Prior Accomplishments: Advanced development efforts were accomplished in the following areas: measurement of changes in institutional racial discrimination in the Army (cited by the Secretary of the Army as the basis for the Army Affirmative Action Plan); evaluation of the President's Clemency Program (incorporated into the Department of Defense's evaluation of the program); evaluation of the Army's Race Relations and Equal Opportunity Program and Training Programs for Race Relations and Equal Opportunity personnel resulting in revisions to Department of Army Pamphlet 600-21; development of diagnostic instruments for use by the chain-of-command in assessing personnel management problems; evaluation of existing race relations training course materials in present courses of instruction; longitudinal monitoring of personnel management and equal opportunity problems of the Army.

2. FY 1978 Program: Determining effectiveness of new equal opportunity (EO) training methods and materials; determine relationships between various EO training techniques and performance of individual soldiers; analysis of the Army Race Relations Education Program; development and evaluation of experimental techniques for commander use in the control, assessment, prediction, and prevention of problems affecting attainment of EO program objectives; development of standardized EO program monitoring systems; provision of data on critical issues in administration of justice and discipline; revision of DA Pamphlet 600-16 to include approaches to problems of institutional bias, sexism and ethnicity; development of continuing sources of information on kinds of soldiers entering the Army; and determining impact of changing personnel policies, current events and societal and demographic changes on Army personnel.

3. FY 1979 Planned Program: Field test and evaluation of standardized EO monitoring system; development and evaluation of innovative strategies for handling dissension and discipline problems; development of new EO strategies and training programs for leaders; development of longitudinal survey instrumentation for periodic determination of soldiers' attitudes and reactions to Army service.

4. FY 1980 Planned Program: Continuation of efforts to improve effectiveness of the Army's Equal Opportunity Education/Training Program; development of alternative EO training models, concepts, techniques, and instructional methods; continuation of efforts to improve methods, techniques, and training for management of EO programs; development of data analysis techniques to utilize longitudinal inventory information to provide better understanding of current Army personnel; determining effects of Army policies on current soldier population.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.47.A
DoD Mission Area: #221 - Medicine & Life Sciences

Title: Soldier Support/Survivability
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1231	1797	2527	3920	Continuing	Not Applicable
D610	Food Advance Development	688	1162	1000	1550	Continuing	Not Applicable
D669	Clothing and Equipment	543	635	1527	2370	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Deficiencies currently exist in meeting the daily basic needs of the individual soldier in protecting him/her against environmental extremes and ever increasing lethality of battlefield hazards. Also, there is a continuing need to improve nutritional value and soldier "acceptance" of rations. This program is designed to satisfy these functional needs. New items of clothing, individual equipment, and field service support equipment will improve the comfort and survivability prospects of the individual soldier through: improved cold and hot weather protective clothing; individual equipment for protection against noise attenuation, blast overpressure, nuclear flash, chemical and biological agents; up-graded working conditions; and improved daily hygiene. New food processing techniques and feeding methods afford opportunities to enhance wholesomeness of subsistance items while at the same time reduce food procurement cost and logistic support requirements.

C. BASIS FOR FY 1979 RDTE REQUEST: Items listed in this program are essential to improving the combat effectiveness of the soldier, fill gaps that exist in the soldier's compatibility with new weapon systems, and increase his efficiency and morale in the field. Prototype items and concepts will be developed to generate preliminary data relative to producibility, cost, and capability of prototypes to meet a defined use and need and/or threat. Program allows for generation of projected life cycle cost and evaluation by developer and user prior to the decision to enter full scale development.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This was a new program element in the FY 1978 RDTE Descriptive Summary and contains two soldier support-oriented projects previously carried in Program Element 6.37.26.A, Combat Support Equipment. These projects include food, clothing, and related personal and protective equipment for the individual soldier. Better combat clothing and individual equipment are essential for the protection of the soldier and to improve his combat performance. A major effort in FY 1979 will be the continuation of development of a ballistic helmet with sound attenuation and other protective clothing items for combat vehicle crewmembers. Department of Defense (DOD) Directive 1338.10-M assigns the Army overall responsibility for the DOD Food Research, Development, Testing and Engineering (RDT&Eng) program. This includes efforts to respond to DOD and other Services requirements re-

lative to their specific operational needs for food and food service equipment, as well as to address jointly those needs which are common to two or more Services. Allocation of funds to the various food program efforts is based on priorities assigned by the Joint Foundation Board comprised of representatives from all Services.

F. RELATED ACTIVITIES: Each of the military Services performs work to develop their Service-peculiar items of clothing and equipment. However, close coordination is maintained, and many of the items developed under this program are used by all other Services. Work in clothing and individual equipment is also performed in Program Element (PE) 6.27.23.A, Clothing, Equipment and Packaging Technology; and in Project DL40, Clothing and Equipment and in Project DL42, Personnel Armor System of PE 6.47.13.A, Combat Feeding, Clothing and Equipment. Related work in food is conducted in PE 6.27.24.A, Food Technology; Project DL47, Wholesomeness Testing of Irradiated Foods and Project D548, Military Subsistence System of PE 6.47.13.A, Combat Feeding, Clothing and Equipment. Basic research in support of both the food and clothing programs is done in Project AH52, Research in Support Equipment of Individual Soldier of PE 6.11.02.A, Defense Research Sciences.

G. WORK PERFORMED BY: In-house work in this program is performed by the US Army Research and Development Command, Natick, MA; US Army Research Institute of Environmental Medicine, Natick, MA; US Army Aero-Medical Research Laboratory, Fort Rucker, AL; US Army Electronics Research and Development Command, Fort Monmouth, NJ; and US Department of Agriculture Stored Products and Insects Research and Development Laboratory, Savannah, GA. Potential contractors include Ro-Search Corp., Waynesville, NC; Gentex Corp., Carbondale, PA; Sierra Corp., Sierra Madre, CA; American Optical, Southbridge, MA; Edmont-Wilson, Coshocton, OH; Westinghouse Electric Corp., Hampton, SC; Geonautics, Newbury, MA; Sandia Corp., Albuqueque, NM; Corning Glass, Corning, NY; Bayonne Stainless Corp., Bayonne, NJ; Avetec Industries, Downers Grove, IL; and Mountain Safety Research, Seattle, WA. Contracts are valued at $767,000.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Physiological studies were conducted to measure differences between standard cold/dry uniforms versus a developmental uniform. Some experimental leathers tested in-house have shown greater water resistance than leather used in the standard direct molded sole boot. A new material called "goretex" was considered for application to vapor permeable/water impermeable rainwear. Laboratory studies have shown "goretex" to have high resistance to the passage of water, while still permitting a satisfactory passage of moisture vapor. A contract was awarded for the design of additional sizes of handwear developed for use when handling petroleum, oils and lubricants (POL) products and for the fabrication of sample mittens. A contract was awarded for fabrication of both high and low pressure inflatable tube structural elements for use in aircraft maintenance shelters. Received oven and proofer assemblies for continuous-flow bakery from contractor. Completed product testing on eight new subsistence items.

2. FY 1978 Program: Complete advanced development (AD) on vapor permeable/water impermeable rainwear, and a cold/dry weather

uniform. Award a contract for additional limited sizes of a modified infantry boot for limited field evaluation prior to Developmental Test/Operational Test (DT/OT) I. Conduct laboratory and physiological studies on POL handwear. Conduct in-house technical evaluation of prototype low pressure inflatable arches and high pressure inflatable beams for possible use in aircraft maintenance shelters. Develop alternative dye/materials which satisfy both military and environmental/safety/health agencies restrictions. Initiate AD on flashblindness protection device for Army aviators, combat vehicle crewmen (CVC) clothing system, and a family of modular general purpose (GP) shelters. Continue improvements on field food service sanitation. Continue development of continuous-flow bakery system integrating the oven components already received into a field bread production system. Complete production process development for eight special purpose subsistence items to meet unique military requirements, e.g., compressed dehydrated vegetables to save on transportation costs and storage space requirements.

3. FY 1979 Planned Program: Complete advanced development (AD) of: flashblindness protection for Army aviators and POL handwear. Fabricate and test prototype designs of ballistic eye protection; award contract for test items of infantry boot for DT I/OT I. Continue AD of the CVC clothing system where the emphasis will be on a ballistic protective helmet with sound attenuation. Complete AD of the continuous-flow bakery system with DT I/OT I scheduled during the first half of FY 1979. Continue development and process definition and description for the DOD new subsistence item program. This latter effort involves new items to meet special military requirements which cannot be met by off-the-shelf subsistence items. Initiate and/or continue AD on nineteen separate service requirements of the DOD Food RDT&Eng program prioritized by the DOD Joint Formulation Board. Increased funding is mainly for the CVC helmet.

4. FY 1980 Planned Program: Continue advanced development (AD) to support items of clothing and equipment not completed in FY 1979. Conduct DT I/OT I on ballistic eye protection. Continue suspension studies and medical design constraints for the helmet component of the (CVC) clothing system and other clothing articles of the system. Continue review of military compounds and end item specifications for conflict with new environmental/safety/health standards. Initiate AD on a camouflage overcolorant kit, ballistic protection for field artillery crews/weapons/ammunition, and a cold weather aircrew flying ensemble. Continue AD to support new subsistence items of the DoD RDT&Eng program.

5. Program to Completion: This is a continuing program.

FY 1979 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.48.A
Title: Automatic Test Equipment
DoD Mission Area: #244 - Mobility and Logistics Technology Demonstrations
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3197	700	2047	6839	Continuing	Not Applicable
AJ29	Automatic Test Support Systems	2598	700	1000	1246	Continuing	Not Applicable
D203	Vehicle Diagnostics	95	0	100	370	Continuing	Not Applicable
D244	Communications Electronics Automatic Test System	370	0	347	623	Continuing	Not Applicable
D633	Automatic Test Equipment Advanced Technology	0	0	400	1000	Continuing	Not Applicable
D635	Missile Automated Test Equipment System	0	0	0	3400	Continuing	Not Applicable
D651	Calibration	134	0	200	200	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The automatic test equipment program will provide the technology required for test, measurement, and diagnostic equipment in support of Army combat and combat support systems at all levels of maintenance. New systems under development are incorporating advanced electronic circuit technology with complex large scale integrated circuits that can no longer be totally supported with conventional test, measurement, and diagnostic equipment. In addition, the present proliferation and lack of interface within commodity oriented test, measurement, and diagnostic equipment has placed a burden on the Army in logistics and training. The advantages of placing automatic test equipment into the inventory include: reduces incorrect diagnosis and unnecessary repairs; reduces diagnostic time and manpower requirement; reduces cost of developing and procuring special, peculiar and common test equipment; and reduces the necessity of large numbers of skilled diagnosticians.

Program Element: #6.37.48.A
DoD Mission Area: #244 - Mobility and Logistics Technology Demonstrations

Title: Automatic Test Equipment
Budget Activity: #2 - Advanced Technology Development

C. BASIS FOR FY 1979 RDTE REQUEST: Investigate Army-wide requirements to determine the design of automatic test equipment to support a broad class of systems at organizational and direct support maintenance. Initiate development of a "suitcase" type of automatic test equipment which will provide go, no-go test capability for organizational level of maintenance to isolate malfunctioning weapon systems to a removable module. Develop the concept of a general purpose "bench" type tester at direct support level of maintenance for diagnostic testing of malfunctioning modules removed at organizational level of maintenance. Develop guidelines and regulations for configuration management of automatic test equipment software and hardware for Army-wide weapon systems developers.

D. OTHER APPROPRIATION FUNDS: Not applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: Dramatic advances in technologies have allowed for development of more complex weapons systems with greater performance capability. In turn, these systems have demanded the development of correspondingly more complex test equipment and test technology. Advanced computer controlled automatic test equipment and simpler automatic test program generation systems must be developed to keep pace with communications-electronics, optical, laser, hydraulic, pneumatic and internal combustion engine development. The objectives of the program are: development of a bench type automatic tester to fault isolate printed circuit boards at the direct support maintenance level; development of a low cost, microprocessor controlled, portable, "suitcase" automatic tester for use at the direct support and organizational levels of maintenance to provide go, no-go testing for communications-electronics equipment; development of standards, guidelines, and aids required by Army systems developers that will be supported by automatic test equipment; and development of automatic test equipment that is missile system peculiar.

F. RELATED ACTIVITIES: Program Elements (PEs) 6.27.79.A (Test, Measurement, and Diagnostics Technology) and 6.47.46.A (Automatic Test Support Systems) accomplish the exploratory and engineering development work, respectively, for work covered under this program.

G. WORK PERFORMED BY: In-house work is performed by the US Army Communications Research and Development Command, Fort Monmouth, NJ, and the US Army Missile Research and Development Command, Redstone Arsenal, AL. Contractors are: RCA Corporation, Burlington, MA; and the University of Pennsylvania, Philadelphia, PA.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

Program Element: #6.37.48.A
DoD Mission Area: #244 - Mobility and Logistics Technology Demonstrations

Title: Automatic Test Equipment
Budget Activity: #2 - Advanced Technology Development

1. FY 1977 and Prior Accomplishments: Completed advanced development (AD) of the AN/USM-410 Automatic Test Equipment for communications-electronics systems application. Provided technical support to Army program managers (PM) in the integration of the AN/USM-410 onto their systems. Convened a Special Study Group of representatives from the various Army equipment developer and user commands to determine the technical capabilities of industry in automatic test equipment and to determine automatic test equipment requirements of the Army. As a result of the study effort, several addendums were submitted to the Automatic Test Equipment Letter of Agreement and a Required Operational Capability (ROC) for the General Support Automatic Test Equipment was initiated. The outline development plan for the suitcase type tester program was initiated. Continued contractual effort to develop and determine the methods of implementing many of the unique automatic test equipment language testing techniques. Continued contractual effort to automatic test program generation development.

2. FY 1978 Program: Prepare for AD phase of the suitcase type tester for communications-electronics applications, and convene an In-Process Review (IPR) to seek approval to enter an accelerated development and acquisition program. Develop documents to assist system developers in planning and budgeting for automatic test equipment for their program, to include: Automatic Test Equipment Acquisition Handbook; Test Program Set Planning and Budgeting Guide; and User's Guide for the Preparation of Automatic Test Program Sets. Conduct a study for the purpose of recommending amendments, changes, or generation of Army Regulations relative to automatic test equipment hardware and software in the materiel acquisition process. Complete contract for automatic test program generation development. Define test program sets generation standardization in order to insure the implementation of uniform interactive software between the automatic test equipment operator and the machine.

3. FY 1979 Planned Program: Prepare the management plans and documents, such as the cost and development plans, to award a two-phased contract for an accelerated advanced development of the suitcase type tester. The first phase will consist of a government/contractor performed trade-off analysis resulting in a system design specification for a low cost suitcase tester. The second phase will design and develop prototype models which will be geared toward supporting specific weapon systems. Initiate the conceptual investigation for an advanced design technology for the bench type tester. Electrical, mechanical, and thermal interface designs will be developed for the system modules.

4. FY 1980 Planned Program: Award a contract to determine the most cost effective approach in developing the suitcase tester to meet the needs of the various weapons systems. Continue contractual effort on the bench type tester for direct support maintenance of electronic equipment. Support for automatic test equipment software will be provided, such as configuration management policies and procedures, and the implementation and management of software support centers. A low frequency electronic test station to support currently fielded missile systems will be designed. Several techniques for interfacing the unit under test to the automatic test equipment will be evaluated and the best technical approaches incorporated into the missile automatic test

equipment design. Commercial equipment will be procured, any necessary equipment of system peculiar design will be fabricated, automatic test equipment operating systems and self-test software not commercially available will be developed, and the missile automatic test equipment system will be demonstrated.

5. **Program to Completion:** This is a continuing program.

FY 1979 BUTF CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: 6.27.70.A
DoD Mission Area: #442 - Logistics/General Combat Support

Title: Drug and Vaccine Development
Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LEVEL): ($ in thousands)

Project Number	Title	FY 1977 Actual	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	0	1000	1619	Continuing	N/A
808	Drug and Vaccine Development	0	0	1000	1619	Continuing	N/A

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Objectives of this program are to further develop antiparasitic drugs and bacterial, viral and parasitic vaccines that have met the requirements in the early program of drug screening and candidate vaccine development in preparation for extended field trials. This program is essential in the advanced development to study pharmacology and toxicity of compounds and vaccines shown active against diseases that constitute a threat to troop mobilization or diseases endemic in areas of potential military operations.

C. BASIS FOR FY 1979 BUTF REQUEST: The logical progression in the development of drugs and vaccines effective for preventing and treating military important infectious diseases required preclinical and clinical evaluation in humans. This new program will effectively fulfill this requirement. Program essential for final development of drugs and vaccines to be stocked and used by the Department of Defense.

D. OTHER APPROPRIATION FUNDS: Not Applicable.

E. DETAILED BACKGROUND AND DESCRIPTION: This program includes the final essential developmental studies for preventive and curative drugs and vaccines used by military personnel against parasitic, viral, bacterial, and richettsial diseases that reduce troop effectiveness and combat and training operations. Candidate drugs and vaccines developed in the early program undergo the necessary advanced pharmacology and toxicity evaluation. These prophylactic and therapeutic products are tested under natural conditions in large scale field trials prior to stocking in the Department of Defense system.

F. RELATED ACTIVITIES: Army studies related to this program are performed under projects 6.27.70/AB02, Military Preventive Medicine and Tropical Diseases, 6.27.70.A/AB03, Drug Development and 6.27.74.A/AB41, Medical Defense Against Biological Agents. Complementary research is performed by the National Institutes of Health. However, the unique aspects of the Army drug and vaccine development program focus on preventing or treating military important diseases which cause morbidity or mortality of troops in combat operations.

Program Element: #6.37.50.A
DoD Mission Area: #442 - Logistics/General Combat Support

Title: Drug and Vaccine Development
Budget Activity: #2 - Advanced Technology Development

C. WORK PERFORMED BY: Approximately 70% of the research will be conducted by the in-house laboratories of the Walter Reed Army Institute of Research and field units in Thailand, Kenya and Brazil. The remaining 30% of the work will be conducted by extramural contracts that will be awarded in FY 1979, which is the initial funding year for this new project.

H. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1977 and Prior Accomplishments: Not Applicable

2. FY 1978 Program: Not Applicable

3. FY 1979 Planned Program: Two or three drugs showing promise in preclinical and clinical studies as prophylactic and/or therapeutic agents for drug resistant malaria will be evaluated in limited field trials. Several antiparasitic drugs will be evaluated in clinical tests for prevention and treatment of leishmaniasis, and important disease occurring in troops conducting operations in endemic areas. A candidate dengue type II vaccine will be evaluated for efficacy in man. Effectiveness in troops of an adenovirus type 21 vaccine will be determined in limited trials.

4. FY 1980 Program: Several antimalarial drugs will be evaluated under limited and comprehensive field tests. Most promising drugs will be submitted for final Food and Drug Administration approval and for stocking in Deparment of Defense supply. A large scale-field trial of adenovirus 21 vaccine for recruit protection will be conducted. When this vaccine development is completed it will be recommended for standard use. Final safety and efficacy tests for an antileishmanial drug will be conducted. Large scale tests for safety and antibody response to a candidate Group B meningococcal vaccine will be conducted.

5. Program to Completion: This is a continuing program.