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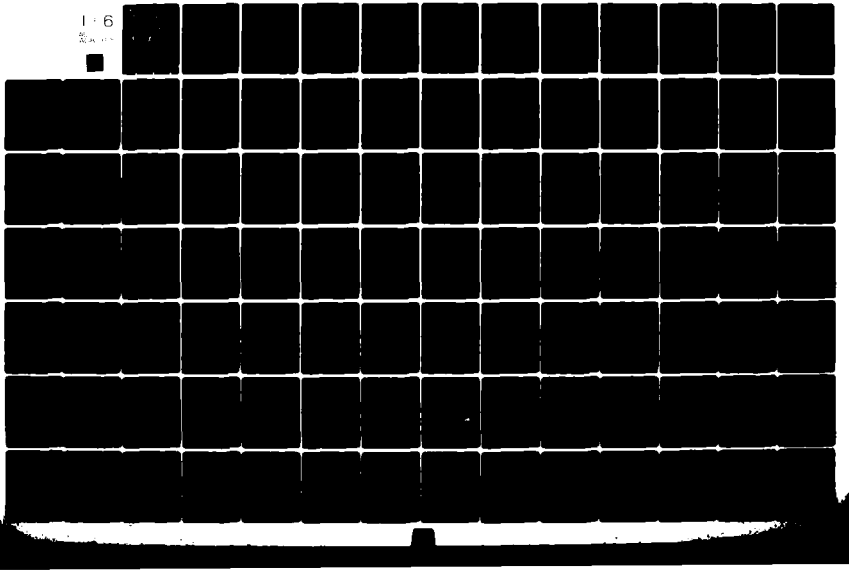

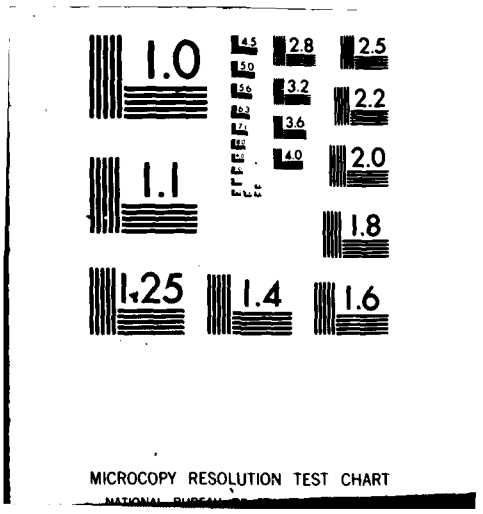
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LEVEL III

VOLUME I

Supporting Data FY 1981
Budget Estimate

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Descriptive Summaries Of The

RESEARCH DEVELOPMENT TEST & EVALUATION

Army Appropriation FY 1981 (U)

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

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VOLUME 1

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS

OF THE

RESEARCH, DEVELOPMENT, TEST AND EVALUATION, ARMY PROGRAM

FY 1981 (U)

JANUARY 1980

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 1981 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 1981. Descriptive Summaries for projects within the program elements to be financed during FY 1981 for $5.0 million or more appear 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 1981. A Test and Evaluation Section is provided for all major weapon systems.

There are seventeen 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 1979, FY 1980, FY 1981, and FY 1982 data in this Program Element Listing with data shown in the Program Element Listing dated January 1979 will reveal significant differences. Many of the differences are attributable to the following factors:

a. Restructuring of the FY 1979 and FY 1980 programs for comparability to the FY 1981 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) Further extension of the Single Program Element Funding Concept.

(3) Restructuring of Exploratory Development personnel RDTE programs.

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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FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.11.01.A
Title: In-House Laboratory Independent Research (ILIR)
DOD Mission Area: #510 - Defense Research
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	16000	17500	19600	21900	Continuing	Not Applicable
A91	In-House Laboratory	16000	17500	19600	21900	Continuing	Not Applicable

B. (U) 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. There were 413 research and development tasks pursued in FY 1979.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: This request is based on the opinion that this program is important to Army laboratories and should be provided modest real growth. 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.

Program Element: #6.11.01.A
DOD Mission Area: #510 - Defense Research

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

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	16000	17500	19600	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	16000	17500	18400	Continuing	Not Applicable

The increase in funds for FY 1981 will provide moderate real growth for this important program.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.11.01.A
DOD Mission Area: #510 - Defense Research

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

F. (U) 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. It also provides a vehicle whereby innovative, high-risk ideas with possible high payoff can be pursued to the benefit of the Army and Army scientists. That is, this program is keyed to increasing innovative creativity and professional competence.

G. (U) 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 topical reviews.

H. (U) WORK PERFORMED BY: In-House Laboratory Independent Research is performed in thirty-eight Army RDTE activities.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments:

a. (U) Natick laboratory, while investigating a new class of compounds for use in surface coatings with substrate textiles, has discovered a new and highly efficient synthesis of a group of compounds. These compounds are chemically similar to chlorophyll and may be of considerable interest as military camouflage dyes. In addition, Natick, through the use of the plastein reaction, has incorporated selected amino acid derivatives into poor nutritional quality vegetable and cereal grains that are deficient in essential amino acids. The process has increased protein content in some grains as much as eightfold with a fifty percent yield of plastein product. A one-step process using soy protein provided a product, obtained in about eighty-percent yield, that had a thirty-percent increase in amino acid content.

b. (U) The Army Materials and Mechanics Research Center has developed a liquid crystal fraction of pitch as a bonding agent and as a thermal insulating material. The isolated liquid crystalline pitch makes an excellent bonding agent not only for bulk graphites but also for carbon and graphite. Indications are that significant cost reduction in the preparation of carbon-carbon composites can be realized from the use of this liquid crystal material.

c. (U) Fire Control and Small Caliber Weapons Systems Laboratory's investigation in enzymatic denitration of small arms propellants is scientifically unique. It is the first known attempt to use enzymes for accurately controlling the gas generation rate of small arms propellants. The use of enzymes for controlling propellant gas generation rates will have significant impact on improving both safety and environmental aspects of propellants during manufacture, storage, and disposal as well as minimizing lot-to-lot ballistic variations. Immediate benefits of this investigation will accrue to the consolidated charge and caseless ammunition program.

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Budget Activity: #1 - Technology Base

d. (U) Combat Surveillance and Target Acquisition Laboratory is exploring the use of laser techniques to detect acoustic signals. Preliminary theoretical analysis has shown that an artillery firing produces an expanding sound wave which produces a density fluctuation in the atmosphere resulting in atmospheric particle displacement. Since the scattering coefficient of the atmosphere is proportional to the density, simple equations were developed to provide several parameters of this interaction of the atmosphere. The analysis demonstrates reasonable values over a wide range of atmospheric conditions. This idea can be classed as a technological breakthrough and will permit locating an array of synthetic microphones over the battlefield in enemy territory to capture the sounds that actuate the scattering particles in the air. Laboratory experimentation to verify the theory and follow-on field testing could provide detection capability against many other weapon systems as well as personnel. The preliminary analysis is promising enough that present plans are to incorporate the continuing research into the FY 1982 core program.

e. (U) Night Vision and Electro-optics Laboratory has developed a unique new cooling device with no contacting parts. This has the advantage of extending seal life indefinitely and making the device acoustically silent. This increases the mean time between failure of most thermal imaging devices to that of the imaging device instead of that of the cooler. Initial analysis of the system shows an increase of from thirty to thirty-five percent more cooling capability than conventional constant velocity piston coolers.

f. (U) The US Army Missile Command Laboratories investigated a novel lock-on-after-launch missile systems concept utilizing infrared imaging devices. A new filter has been developed, called the "spoke filter", which has detected ninety-eight percent of the targets in the data base presented to it. The filter is based on a concept similar to detectors for circles but functions on objects which vary in scale and deviate from a circular shape. Overall performance has resulted in over ninety-six percent of the targets being correctly classified as targets with a false alarm rate ranging from zero to ten percent depending on the composition of the feature vector. Hardware for the first system prototype should be operational within eighteen months.

g. (U) Harry Diamond Laboratories has developed a unique method for performing a realtime Discrete Fourier Transform through the use of a Triple Product Convolver device. The device launches a contrapropagating linear frequency modulated signal from its left and right surface acousto-optic wave transducers. At the same time a number of discrete light beams containing a certain amount of information illuminate a crystal surface and are summed. The interaction of the surface acousto-optic wave transducers and the discrete light beams illuminating a crystal interact to perform a realtime Discrete Fourier Transform. Application of this device is in beamforming, a technique that can produce a frequency versus azimuth format of sound waves. By correlating the various frequency versus azimuth outputs of a number of sensor arrays, position location of several artillery pieces can be simultaneously obtained. This system is a joint Harry Diamond Laboratories and Combat Surveillance and Target Acquisition Laboratory project.

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h. (U) Large Caliber Weapon Systems Laboratory's pursuit of coating techniques to reduce the interface interaction between tungsten filaments and the staballoy matrix resulted in the discovery that a variety of refractory coatings can, in themselves, degrade filament strength and ductility. Tantalum coatings deposited directly onto the tungsten filament by electrodeposition from fused salts decreased both the ultimate tensile strength and/or ductility of the filament depending on the coating thickness. A duplex coating of electrodeposited copper and chemically vapor-deposited tantalum was developed that did not degrade either tensile strength or ductility. Such a coating may provide the missing link in heavy metal composite materials for kinetic energy penetrators.

i. (U) The US Army Research and Technology Laboratories of the Aviation Research and Development Command are developing a method of visualizing rotary wing aerodynamics and noise. It is a known fact that attached shock waves form on the upper and lower surfaces of modern helicopter rotors. This phenomenon was thought to be localized until new research showed this not to be the case, and in actuality, the local shock waves appear to feed a radiating shock wave. The resulting noise propagation is responsible for the acoustic detection and identification of Army rotary wing aircraft in high-speed flight. A laser holographic flow visualization system has been fabricated and has verified the potential of producing a three-dimensional picture of the flow density gradients created by a rotating high tip speed model rotor. The techniques should provide visual and quantitative data to understand the physical process of impulsive rotor aerodynamically generated noise formation and propagation to the far field.

j. (U) Ballistic Research Laboratory investigated the feasibility of high burn-rate propellants as high-impulse, short-loadtime guidance thrusters. The task determined that the state-of-the-art thruster design requirements can be satisfied by a Hirelite propellant thruster, as the impulse was found to be within the required duration and there was no structural damage to the simulated shell casing. This task will be continued as part of the core-funded program to develop novel guidance thrusters for smart tactical weapons.

k. (U) The US Army Electronics Technology and Devices Laboratory developed techniques for the characterization and qualification of semi-insulating gallium arsenide crystals intended for device applications. The electrical compensation and transport properties of these crystals as a function of growth parameters were investigated. The electrical characteristics of pressure synthesized crystals were studied by analyzing the variation of resistivity and Hall parameters with magnetic field and temperature. A mixed conduction analysis was formalized allowing the determination of individual carrier parameters. The resulting research findings have been constructively applied to the ongoing laboratory synthesis program and have been disseminated to equivalent peer groups in industry. These findings can reduce impurities incorporated during processing and lead to higher purity, more stable and reproducible crystal substrates for use in the next generation electronic devices.

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l. (U) The US Army Tank-Automotive Concepts Laboratory developed techniques for investigating the acoustics and structural vibration characteristics of large military vehicle components using pulsed holographic analysis. Excellent quality holograms have been taken. A single hologram contains large fringe densities over a large area of the vehicle. Analysis of the fringe data clearly indicates regions on the vehicle which have large amplitudes and stress levels and transfer paths for vibrational energy. This method is useful for finding localized regions of high vibration intensity almost impossible to find in some cases with accelerometer transducers alone. The usefulness of these holographic methods is particularly evident in the vehicle design prototype stage where a large overall picture of vehicle dynamics is achieved quickly and economically to implement rapid design change.

m. (U) White Sands Missile Range pursued methods of processing video information in realtime for tracking and for man-machine interaction optimization. Image structures were analyzed statistically to enable selective enhancement of objects concealed in low-contrast background imagery. Considerable research was performed in adapting known image processing techniques to realtime applications by devising iterative and recursive methods capable of on-line complex image analysis. Algorithms were demonstrated in the laboratory to produce a previously unattainable level of image understanding of video. One such algorithm based on a moment method was demonstrated to decompose images based on color boundaries. Several new image understanding algorithms were developed. These techniques will be incorporated into instrumentation at the range and will enhance range instrumentation capability.

n. (U) The Human Engineering Laboratory developed a bright pupil measurement system which permits execution of experiments of greater complexity and power than previously possible. The new system allows the use of dark-eyed subjects previously unuseable and has no physical connectors to the subject. This reduces the physical and psychological inhibition of the subject during eye movement test.

o. (U) The US Army Institute of Dental Research worked on a unique method to diagnose the exposure of combat troops to lethal agents through evaluation of saliva. It was determined that exposure to cholinergic chemical warfare agents alter salivary protein composition to a significant degree which allows for diagnostic evaluation of agents. Thus far, changes in the point at which red blood cells unite into groups and differences in elementary composition under the influence of nerve gas indicate that these parameters may have diagnostic value and may be applicable to the combat soldiers. The changes noted were restored to normal by the administration of antidotes.

p. (U) The Army Institute of Surgical Research worked on identification of the mechanisms involved in reduced white cell protection against infection following burn injury. Reduced functioning of white blood cells occurs in a setting of increased reaction of the total body metabolism related to increased levels of adrenal gland activity. The white cell defects

occur in concert with impairment of glucose utilization by the leukocytes. In vivo granulocyte adherence, which is essential for movement of the white cells, is significantly reduced. Impaired white cell function predisposes the burn patient to a high incidence of infections and fatal toxic condition. Identification of these specific white cell defects and elucidation of the responsible mechanism will permit development of means to prevent or correct these dysfunctions and improve survival of the badly injured patient.

q. (U) The Army Medical Institute of Infectious Diseases developed a rapid method for quantification of viral antibodies and antigens. Radioimmunoassay was tested against the conventional method and found to be more rapid, sensitive, reproducible, and precise. The new method is recommended to replace more conventional means for routine testing of sera for alphavirus antigens. The validity of the method is being used for testing coded sera. Radioimmunoassay is presently being adapted to Rift Valley fever and yellow fever viruses. Through further development of sensitivity and adaptation, this new procedure holds promise for identifying candidate vaccine lots with greater potential and may eventually replace the present potency assay.

r. (U) The Letterman Army Institute of Research developed a nontoxic cryopreservation system which does not require post-thaw washing or other manipulation of the platelet concentrates. Liquid-stored platelets with a 72-hour storage life are impractical while frozen-thawed platelet concentrates could be used, but required extensive post-thaw manipulation and washing due to toxic cryopreservatives. The nontoxic cryopreservation system is made up of 4 percent glycerol-5 percent glucose as the cryopreservative with no-wash, post-thaw properties. An optimization protocol to freeze a therapeutic dose in one bag has been developed, and in vitro tests have been devised to evaluate viability. This project is being transferred to the core program for advance development.

s. (U) Walter Reed Army Institute of Research made significant progress in two areas: the improvement of existing culture technology to produce parasite antigens and the treatement of shock due to bacterial endotoxins, blood loss, and neurogenic trauma. In the first area antigens have been prepared for experimental immunization analysis of cross-reactivity with other parasites and comparative studies of parasite and host enzymes and their inhibitors. Parasite growth was inhibited by immune monkey serum. Studies using synchronized cultures demonstrated that merozoites are the targets of the serum which results in blocking penetration of uninfected blood cells. The process has promise for developing a vaccine against malaria parasites. In the second area initial research has shown that Naloxone will reverse shock due to bacterial endotoxins, blood loss, and neurogenic trauma. Further, this research has provided important data suggesting a major role of endorphins in the mechanism for producing shock. Provision of an immediate and successful treatment for shock will gain important time for the institution of definitive measures in the treatment of disorders leading to shock.

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DOD Mission Area: #510 - Defense Research

Title: In-House Laboratory Independent Research (ILIR)
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t. (U) The Engineer Topographic Laboratory has developed a detection scheme for detection of signal signatures of cartographic features using electronic methods. The new unique technique incorporates electronic equipment programmed to identify select parameters of certain manmade features by their signal signatures. The success of the research has provided a base whereby further development shows definite promise for identifying other types of features. This work will be transitioned into the core program.

u. (U) The Army Cold Regions Research and Engineering Laboratory has been developing the capability to model and effectively predict frost action in soils. Such action is a pacing problem whose solution is critical to major aspects of both military and civil works programs. An extremely new and advanced computer analysis method was developed and verified to handle boundary area phenomena, allowing a finite element formulation in space to be cast in a moving, deforming coordinate system. The feasibility of characterizing the resilient modulus of soils in terms of moisture stress was demonstrated and applied to on-going programs. Successful laboratory experiments indicate a real possibility that a rational creep theory for frozen soils is attainable. Continued research suggests development of an effective model to predict frost susceptibility and interaction in soils.

v. (U) Waterways Experiment Station discovered that present methods of measuring densities of fecal coliform bacteria in overland flow projects was erroneous. False positive isolates, thought due to waste water runoff, were actually due to isolates giving a positive response because of excessive colony count per plate of indigenous fecal coliform, synergisms occurring between true fecal bacteria and a species indigenous to the system, and fecal bacteria which originate from sources other than the wastewater. Greenhouse testing with wastewater overland flow systems showed 75-90 percent of the bacteria were removed from the wastewater by overland flow systems. Movement of the bacteria with the overland flow is rapid; however, the fecal bacteria die off rapidly following cessation of the flow, with almost total die-off within a few days. This indicates requirement for new methods of measuring the type of bacterial contamination of overland flow systems.

w. (U) The US Army Bioengineering Research and Development Laboratory has developed effective biological control agents for mosquitoes. The efficient, safe, inexpensive, storable, and resistant-to-degradation-in-the-environment characteristics of the two protozoan mosquito pathogens are being used as models to develop and test protocols for the evaluation of mosquito pathogens. To date, mosquito/protozoan systems have been established in the laboratory. Spore production in the natural host has been optimized. Purification procedures have been developed. Efficiency and storage experiments have been completed. Studies of mass production potential, safety, and environmental durability are in progress.

2. (U) FY 1980 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 subsequent fiscal year. Directors of individual laboratories or

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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 utilize their in-house laboratory independent research funds.

3. (U) FY 1981 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 for FY 1981 will provide an increase for this innovative program in support of directives to increase research efforts.

4. (U) FY 1982 Planned Program: The program will be continued with the same management policies and objectives.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

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

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	98058	113652	137311	164452	Continuing	Not Applicable
AF22	Research in Vehicular Mobility	400	600	850	1200	Continuing	Not Applicable
AH42	Research in Materials and Mechanics	2100	2350	2650	3330	Continuing	Not Applicable
AH43	*Research in Ballistics	6400	6822	7400	8500	Continuing	Not Applicable
AH44	Research in Fluidics, Nuclear Effects, and Ordnance Electronics	2250	2485	2900	3430	Continuing	Not Applicable
AH45	*Air Mobility Research	5355	5745	6750	7800	Continuing	Not Applicable
AH46	Research in Combat Surveillance and Target Acquisition	200	200	300	600	Continuing	Not Applicable
AH47	Electronic Devices Research	2000	2400	2650	3150	Continuing	Not Applicable
AH48	Electromagnetic Propagation and Antenna Research	1200	1345	1500	2120	Continuing	Not Applicable
AH49	Missile and High Energy Laser Research	1650	2000	3100	4040	Continuing	Not Applicable
AH51	Combat Support Research	800	1000	1150	1310	Continuing	Not Applicable
AH52	Research in Support of Equipment for Individual Soldier	1750	1932	2200	2420	Continuing	Not Applicable

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
BH57	*Research in Scientific Problems with Military Applications	30107	38608	49000	60500	Continuing	Not Applicable
AH60	*Research in Large Caliber Armaments	5100	5515	6500	7620	Continuing	Not Applicable
AH61	Research in Fire Control and Small Caliber Armament	806	1082	1500	2070	Continuing	Not Applicable
AH63	Research in Electronic Warfare	100	300	400	600	Continuing	Not Applicable
AH68	Processes in Pollution Abatement Technology	200	218	240	270	Continuing	Not Applicable
BS04	Identification and Health Effects of Military Pollutants	421	450	500	560	Continuing	Not Applicable
BS10**	*Research on Military Diseases, Injury and Health Hazards	19037	21102	25320	28900	Continuing	Not Applicable
AT22	Research in Soil and Rock Mechanics	425	569	605	710	Continuing	Not Applicable
AT23	Basic Research in Military Construction	510	558	650	760	Continuing	Not Applicable
AT24	Research in Snow, Ice, and Frozen Ground	1425	1428	1725	1950	Continuing	Not Applicable
A31B	*Night Vision and Electro-optics Research	6100	6494	7600	8780	Continuing	Not Applicable

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DOD Mission Area: #510 - Defense Research

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Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
B52C	Research in Geodetic, Geographic, and Mapping Sciences	1362	1483	1600	1750	Continuing	Not Applicable
B53A	Research in Atmospheric Sciences	3300	3694	4021	4502	Continuing	Not Applicable
A71A	Research in Defensive Systems for CW/BW	1460	1625	2200	2730	Continuing	Not Applicable
B74A	Research in Human Engineering	1250	1537	1800	2220	Continuing	Not Applicable
B74F	Basic Research in Behavioral and Social Sciences	2356	2110	2200	2630	Continuing	Not Applicable

* These projects are covered by separate descriptive summaries.
** Former projects BS01, BS02, BS03, BS05, BS06, BS07, and BS08 have been combined under new project BS10.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Research performed under this program in the physical, biological-medical, engineering, environmental, and behavioral-social sciences initiates new developments leading to new Army capabilities and provides solutions to identified Army problems. Each project is associated with a particular Army mission. Flexibility exists to take advantage of scientific and technological opportunities. This research program responds to high priority capability requirements as stated in the Army Science and Technology Objectives Guide.

C. (U) BASIS FOR FY 1981 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 new objectives defined by the Army user.

Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	98058	113652	137311	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	100305	118680	140792	Continuing	Not Applicable

In the FY 1980 submission, the FY 1979 funding for project BH57 was $31,950. Of this amount $3,450 were for the management and support costs for operating the Army Research Office and were to be provided from program element 6.58.01.A, Programwide Activities. Actually, only $2,352 were provided from 6.58.01.A. This deficit was partially compensated for by reprogramming $361 to BH57 from other 6.11.02.A projects as follows: AF22, $30; AH43, $86; AH44, $40; AH45, $10; AH48, $20; AH49, $30; AH52, $30; AH60, $60; B53A, $15; and B74A, $40. Further, a recent report submitted by the Army reported only the transfer of $1,246 from program element 6.58.01.A rather than the actual amount of $2,352. To be consistent with this recent report the figure of $30,107 is used here for the funding of project BH57, however the actual funding for project BH57 in FY 1979 was $31,213. The $1 increase in BS04 and the $44 decrease in BS10 were minor funding adjustments near the end of the fiscal year to make maximum use of available funds. Effective 1 July 1979 the Biomedical Laboratory that was part of the Chemical Systems Laboratory at Aberdeen Proving Ground was made a separate laboratory reporting to the Army Medical Research and Development Command. The 6.11.02.A funding for this laboratory, that was formerly provided under project A71A, will now be provided under project BS10. The following amounts were transferred from A71A to BS10: FY 1979, $440; FY 1980, $450 and FY 1981, $520. For FY 1980, except for the $450 transferred from A71A to BS10, the only project funding changes between the FY 1980 submission and current requirements were reductions necessitated by the Congressional reduction of $4,680 in this program element, reductions totaling $112 made in response to the Congressional direction to reduce travel and overtime, and reductions totaling $236 made in response to the Congressional direction to reduce service support contracts. For FY 1981, most of the differences between the FY 1980 submission and current requirements were reductions made to bring the FY 1981 program down to current funding guidance. However, six projects were increased for the following reasons: The increase of $350 in AH45 will provide a new effort in avionics to enhance helicopter mission capability, safety and performance; the increase in AH49 of $200, A31B of $100 and B53A of of $221 are all aimed at increasing our ability to operate in inclement weather conditions; the increase in BS10 of $974

Program Element: #6.11.02.A
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will increase emphasis on that portion of the combat care science aimed at protecting the soldier from the effects of chemical agents, will provide a modest expansion in basic technology supporting drug and vaccine development, and will provide integration of the science base for health hazard assessment; and the increase of $320 in project A71A will improve our chemical decontamination capability.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

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F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program supports research in 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 dental sciences; biological sciences; food; clothing; soldier support; night, dirty battlefield, smoke, and foul weather operations; terrain characterization; vehicle mobility; navigation; and human-weapons integration. Research in the physical and engineering sciences is 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 contracts with the academic community, industry, and not-for-profit organizations are administered by the Army Research Office, an agency of the US Army Materiel Development and Readiness Command. Research in environmental sciences, military construction, and positioning 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.

G. (U) 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; review of the scientific literature; and publications of current research. 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.

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H. (U) WORK PERFORMED BY: The research supported under this program is performed by in-house laboratories and activities and by academic institutions, not-for-profit organizations, and industrial laboratories through contracts. 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 Materiel 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
Communications Research and Development Command, Fort Monmouth, New Jersey
Electronic Warfare Laboratory, Fort Monmouth, New Jersey
Missile Command, Redstone Arsenal, Alabama
Mobility Equipment Research and Development Command, Fort Belvoir, Virginia
Natick Research and Development Command, Natick, Massachusetts

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, Washingon, DC
Letterman Army Institute of Research, Presidio of San Francisco, California
Medical Research Institute of Infectious Diseases, Fort Detrick, Maryland
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
Biomedical Laboratory, Aberdeen Proving Ground, Maryland

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US Army Materiel Development and Readiness Command:

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 Carolinia
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

Office of the Deputy Chief of Staff for Personnel:

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

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Significant progress was reported by the Tank Automotive Command in analysis of gun/chassis dynamics of tanks, gunner performance, and stresses and heat flow in track pads. Gunner performance was not influenced by track vibrations. Previous models of dynamics of tanks in soft soils have been verified and correctly predict performance. Army Materials and Mechanics Research Center devised simplified computer models for shear which correctly predict deformation behavior, and for shock wave propagation in steel and casings for explosives. Earlier research produced cost-efficient procedures for producing tungsten penetrator projectiles, and methods for attenuation of blast pressures by foams. Researchers at the Ballistic Research Laboratory have discovered a possible new catalyst for use in nitramine propellants, and designed computer codes which predict dangerous flight instabilities in cannon projectiles with liquid payloads. Other computer codes were derived to permit early tracking in fire control for air defense. New armor and armor penetration materials and a better understanding of propellant ignition and combustion were acquired in prior work. Air Mobility research led to the development of three dimensional lifting codes to predict load capabilities of tactical helicopters. Recent

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theoretical results for high-speed impulsive noise have provided an understanding of blade acoustics. An important rotor blade milestone was achieved when silicon nitride blades were sintered to high strength and retained their original contour and aerodynamic properties. These discoveries will lead to rotor blades with more durability, impact, and ballistic survivability. The accomplishments of research in large caliber armaments are reported in a separate descriptive summary. Small caliber armaments research formulated predictive procedures for assessing effects of thermoelastic stresses in gun barrels. Also, new areas of fire control for tank armaments involving improved target location, tracking, and rapid computations for aiming and feedback of hit-miss information have been explored. Harry Diamond Laboratories produced acousto-optic memory signal processing devices for signal storage and automatic comparison of the stored signal with an incoming signal. Electronics Technology and Devices Laboratory successfully produced chromium free gallium arsenide substrates for evaluation in millimeter wave generators, produced improved resists (masking polymers) which will make possible much finer printed microcircuits, discovered harmful defect mechanisms at the interfaces in silicon wafers involving trivalent silicon, and discovered novel methods for producing very large crystals of berlinite for portable frequency control and surface acoustic wave filters with exceptional temperature stability. The efforts of this program have now achieved vanguard status in the electronics technical community. At the Communications R&D Command, an efficiency-bandwidth study of low profile antennas was completed which will lead directly to product development of optimally effective communications antenna design. The Missile Command's laboratory demonstrated that submillimeter wave radiation (.89 millimeters) developed by a laser pumped emitter can penetrate fogs through several kilometers with very little loss in energy. Also, their experiments in optical holography resulted in development of a holographic zoom lens, and reflective, focusing, and multicolor filters for possible use in missile seekers. Night vision and Electro-Optics Laboratory research resulted in new millimeter wavelength lasers, new detecters with higher efficiencies in the night vision wavelengths, and detectors for the far infrared frequency ranges which do not require cooling to extremely low temperatures, thus eliminating troublesome weight and power drain requirements. Novel accomplishments also include concepts and new materials for a new miniature laser designator and associated electro-optical elements. Electronic Warfare laboratories exploited new light sources called quasi-homogeneous sources which are not lasers but which show a far-field intensity pattern very similar to lasers. They have begun work on design of an electrically large very high frequency antenna for studying terrain effects on direction-finding accuracy. The Mobility Equipment R&D Command Laboratory responsible for power sources and generators for mobile units, showed that certain fluorosulfonic acids are superior as electrolytes for modern fuel cells. They also achieved graphite fiber intercalation to obtain electrical conductors with greater strength and high conductivity. Food research at Natick Laboratory continues to yield methods for rapid evaluation of the quality and nutritional value of foods and to provide advances in packaging and preserving wholesomeness. Accomplishments from Army-sponsored programs in academic and not-for-profit institutions are reported in a separate descriptive summary for BH57. Research in medical and dental sciences has now been consolidated into a new single project (BS10) to streamline the management of the

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program. The many outstanding accomplishments for this project are reported in a separate descriptive summary for BS10. Work continued on identification and health effects of military pollutants. A new protocol and new methodology were developed which promise to reduce time and cost of long-term testing of health effects. Army construction engineers determined the economic and technical advantages of converting industrial waste materials into useful construction materials. They have completed several studies in energy conservation, pointing out the potential savings in using industrialized building methods in several Army projects. They devised analytical systems to evaluate the economics of construction procedures and for more efficient energy utilization in military construction. Cold Regions research engineers completed a multiyear observation of the Alaska pipeline and haul roads and a method for profiling ice/snow thickness on lakes and rivers. Research continued in mapping and geodesy in order to develop and apply new concepts and methodologies to the solution of military topographic problems. Accomplishments last year include: design of a new formating procedure for incorporation into an automated pattern recognition search system; completion of an evaluation of a new photographic emulsion to record holograms; and completion of a report on the relationship between soil moisture and texture. Scientists and engineers at the Atmospheric Sciences Laboratory completed models of dust/cloud obscuration which have achieved wide acclaim. This work will guide the development of smoke munitions and military tacticians on how to operate most effectively in battlefield smoke/dust and in foul weather. Research in chemical/biological warfare defense yielded a new approach to virus detection through enzyme-linked antibodies. Smoke research at Chemical Systems Laboratory is outstanding. New smokes for obscuration over a wide spectral range have been discovered and are being exploited. This work has yielded a more thorough understanding of the behavior of smoke/aerosol particles once dispersed, and the nature of their interaction with light. The Human Engineering Laboratory completed a maxwellian view optical system, providing a very sophisticated and precise method for evaluating stimuli to the eye and psychological and combat performance. They have initiated a research program to optimize the design of weapons systems training devices. Army Research Institute's behavioral scientists continued to obtain basic knowledge to improve our data base in support of Army personnel training and education programs. They have now completed research in the effects of leadership strategies in response to stress; demonstrated methods which may explain human learning behavior; completed tests of utilization of the operators hand as an input device by optically superimposing the data image over the hand; and established a relationship between an individual's self-assessment of sense of direction and his/her actual navigational abilities. Similar tests on truck drivers of self-reported versus actual abilities showed a correlation. They have established that in training observers and gunners, high visual tracking performance capability will not necessarily predict ability to perform command and control tasks when visual input is not available.

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2. (U) FY 1980 Program: Improvements are being made in the analysis and modeling of weapon station/chassis dynamics which in turn will lead to improvements in combat vehicle performance. Vehicle signature suppression measures will be devised for the entire tank. Materials and mechanics research includes gun tube wear and erosion prevention, new high-temperature ceramic materials investigations, directionally cooled eutectic alloys for aircraft engines, porous materials for noise reduction, theoretical modeling of effects of extremely high pressure due to ballistic impact and exploding munitions on armor, and an investigation of inelastic effects on crack growth in armor due to several different stress modes. A separate descriptive summary is provided to describe the FY 1980 program in Ballistics Research (AH43). Highlights of this program are experimental and theoretical investigations of the mechanisms of initiation and propagation of explosions in new insensitive high explosives and computer modeling of penetrator armor dynamics to aid in design of armor and penetrator materials. Air Mobility research provides basic data for design of helicopter rotors, aerodynamics, propulsion systems, and safety and survivability for rotary wing and very short take-off and landing (VSTOL) aircraft; program details are provided in a separate descriptive summary for AH45. A separate summary is also provided for Large Caliber Armaments Research (AH60). Fire Control and Small Caliber Weapon Systems Laboratory investigates new approaches and techniques for target location and will demonstrate previously developed theoretical control concepts for weapons stabilization. At Harry Diamond Laboratories, researchers are conducting experimental and theoretical investigations of electron charge transfer at integrated circuit/substrate/insulator interfaces and are exploiting lightweight, compact ways of utilizing acousto-optical signal processing. New and more powerful near millimeter wave sources previously developed must be made smaller, and beam characteristics must be better controlled; these are prime concerns. In addition, they explore ion beam, neutron, X-ray, and other potential new energy sources for nuclear weapons effect simulation. Fluidic interface devices are being examined for compatibility with electronic systems. Combat Surveillance and Target Acquisition Research is being conducted in multiplexing schemes, preprocessing schemes, and pseudo-random noise matched filters for adaptive antenna arrays used in target location and tracking, new methods for rapid acquisition of spread spectrum signals, and target classification and identification by means of Doppler frequency signatures. Electronics Technology and Devices Laboratory's research continues to yield very useful information on materials for magnetic/dielectric devices, and new materials for semiconductor devices aimed at high-speed electronic warfare and target acquisition signal processing. Research topics include electron beam fabrication of prototype submicron printed circuits, new polymers (called resists) as sensitive masking materials for submicron lithography, new substrate materials, molecular beam epitaxy, new ferrite materials for receivers in the microwave frequencies, and rare-earth magnets for millimeter wave generators. Technologies developed for new gallium arsenide substrates and new ferrites for special electronic warfare devices are being transferred to other Army and industrial laboratories for application. Mechanisms of reactions in cells consisting of lithium electrodes with inorganic electrolytes are being explained. These will be the chief components for improved electricity-producing batteries to provide power for laser designators. Research in the areas of communications electronics continues to be directed toward new or

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improved communications, command, and control capabilities for the Army. This project explores distributed information processing concepts, real time adaptive algorithms, and multi-hop digital radio nets; develops experimental procedures and analytical tools to acquire, process, and analyze wide-band propagation data in rough or foliated terrains; and has begun to investigate the mechanism responsible for radiation-induced loss in optical fibers. Research at the Missile Command involves millimeter and submillimeter wave propagation and imaging. Investigations include laser-induced photogeneration of catalysis and experimental verification of the dipole laser as a new method for generating high laser power. Night Vision and Electro-Optics Laboratory's research in new far-infrared sensor materials and concepts, electro-optical elements for optical signal processing and their investigations into new laser concepts and materials are described in a separate descriptive summary for project A31B. Research in Electronic Warfare involves theoretical and experimental verification of propagation models for locating enemy emitters, techniques for the identification of broad band radio signals in a multisignal environment, and new signal detector materials with a wide wavelength range of applicability including the ultraviolet region. Polarization signatures of basic optical components are being analyzed. Polarization of light by optical components may be a valuable method for detection, identification, and tracking. Research in combat support and support of the individual soldier is concerned with responses of mine structures to canetip blast; theory and experiments in light reflectance and emission by clothing dyes and camouflage pigments; fuel cell catalysts for efficient silent generation of electrical power; nutritional and metabolic effects of glycerol; nutrient changes imposed through cooking meats by roasting in conventional or microwave ovens; food analysis and composition; recovery of bacterial cells from foods after they have been heated, frozen, or otherwise processed, to evaluate the processing procedures; and continuing the development of a model of taste psychology and chemistry. The Natick Laboratory also conducts research in interaction of lasers with clothing material in order to determine factors leading to enhanced protective characteristics against intense heat such as high-energy laser radiation. Over the years, the Natick Laboratory has continually provided world leadership in nutrition, food storage concepts, food acceptance, protection from microbial degradation, clothing, and camouflage concepts. Pollution Research conducted at Chemical Systems Laboratory deals with methods for assaying and reducing water and air pollutants from ammunition plants, and other military installations. Research in identification and Health Effects of Military Pollutants at the Bioengineering R&D Laboratory involves toxicological testing and assessment and studies of the metabolic fate of pollutants. Other activities of the Army Medical Research and Development Command's laboratories are reported in a separate descriptive summary for project BS10. Project BS10 is a new project which combines seven projects from previous years. These projects were BS01, BS02, BS03, BS05, BS06, BS07, and BS08. A separate descriptive summary is also provided for project BH57. Project BH57 supports a vigorous program of research contracts with academic and not-for-profit institutions, and industry. The Corps of Engineers laboratories are engaged in construction research in pavement precasting and use of precasts, effects of explosives on structures and development of standoff procedures for detecting minefields. Comparisons between predicted and actual industrial building

costs are being made to test predictive ability with military construction. Mathematical equations and computer algorithms relating building energy consumption to weather and occupancy data are being formulated. Snow and ice research on freeze-thaw cycles such as that observed in the winter Reforger exercises are to be continued. The objective of this work is to learn the properties of terrain surfaces and subsurfaces of frozen earth and their possible effects on winter military operations. Research in mapping sciences includes optimization of methods for determining deflections from the vertical in gradient mapping, assessment of the value of optical mass memories for storing maps and imagery, and an evaluation of acousto-optical waveguide spectrum analysis for the automatic extraction of cartographic features. Atmospheric Sciences Laboratory is engaged in validation of smoke/dust/dirty battlefield radiative transport models to describe see-throughability. This basic information will be invaluable to designers of surveillance devices and missile seekers. Wind transport diffusion, particle scattering by smoke, natural aerosols, dust and debris, and gaseous absorption are taken into account in the models. Also, algorithms are being completed and optimized for using sound to locate and range on the dirty battlefield. Researchers in Defensive Systems for Chemical Warfare and Bio-Defense are confirming a new approach to virus detection through enzyme-linked antibody detection of tissue cell antigens. New starts include a determination of the kinetics and mechanism of laser-induced decontamination of chemical agents. Also, they are analyzing mechanisms of molecular permeation through polymeric films for potential new designs of decontamination equipment. Their basic work in the smoke program consists of increasing effectiveness of new candidate smokes in the infrared and millimeter wave regions, and determination of smoke properties to enhance our capabilities to operate under limited visibility. Army Research Institute initiated a program on methods for determining manpower and training or retraining requirements for complex weapons systems in the design state. Research on use of computer-aided instruction in training or retraining for manual skills is being continued. Decentralized training using computer-aided instruction, simulation devices, and other job aides is emphasized, as is determination of schedules of forgetting for various types of skills, to assist in developing schedules for retraining for different skill complexes. The influence of feedback systems upon job performance effectiveness is also being continued.

3. (U) FY 1981 Planned Program: Combat vehicle research will be performed to improve target identification techniques via optical Fourier analysis; to develop a three-dimensional vehicle dynamics analysis for fire-on-the-move capabilities; and to begin advanced diesel combustion modeling and engine burst power investigations. Research in Materials and Mechanics will: develop new and improved materials, processing techniques, and data bases for characterization and evaluation of new materials such as glass/epoxy and graphite/epoxy composites; investigate material causes of gun barrel erosion; exploit the use of nickel whiskers for camouflage; and initiate work on new polymers and polymer structures. Some of the sophisticated methodology to be used in characterizing materials include gel permeation chromatography for polymers, theoretical modeling of effects of environment on composites, X-ray diffraction methods for measuring stress, and crack initiation prediction coding. Research in

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Ballistics will provide a science and engineering base to advance, extend, or exploit results which show a potential for future applications to armaments or ordnance technology. A separate descriptive summary (AH43) provides more details. Projected accomplishments for large and small caliber weapons research include: predictive models of ignition and combustion behavior of gun propellants, reduction of large cannon barrel wear and erosion, new armor penetrators and an understanding of how they behave in penetrating armor, new imaging devices for fire control, prediction of small caliber gun failure mechanisms, and a determination of relationships between strain hardening and adiabatic shear susceptibilities in steels and materials for armor penetration. Harry Diamond Laboratories will examine the physics of electron or charge transfer in dielectrics for high-density integrated circuits and optical, microwave, and infrared sensors; explore the considerable benefits of hybrid integrated optics in acousto-optical signal processing; and devise new 140 and 300 gigahertz near millimeter wave sources for potential use in penetrating fogs and battlefield smokes. Research in combat surveillance will continue to develop theoretical and analytical relationships in data transmission, acoustics, and electromagnetic radiation. Intensive effort will be to explore radar and radiometric techniques for detection of unique scattering or vibrational signals from targets for identification and tracking. High-speed electron beam lithography will be used at Electronics Technology and Devices Laboratory for very high speed integrated circuits needed in electronic warfare signal processing, adaptive signal sorting, and synthesizers. Newly discovered high-quality gallium arsenide will be tested in millimeter wave sources in order to drastically increase power of devices for systems integration into signal intelligence data links. The qualities of berlinite as radio crystals and substrates will be evaluated and the synthesis of high resistivity gallium arsenide for field effect transfer in integrated circuits will be completed. Techniques for making new, high merit rare earth-cobalt magnetic material and for the synthesis of new cathode materials for rechargeable lithium batteries will be transferred to industry. Communications R&D laboratories will complete their research of multi-element antennas and complete their analysis of radio wave reconstitution in the near field of a transmitter. They will also develop a theoretical basis for applying the results of narrow band channel measurements to wide band system performance prediction. Optical fiber experiments to achieve low loss, radiation-resistant, graded and step indexed optical fibers will be continued. At the Missile Command, researchers will complete a definition of the future Army missile in terms of aerodynamics and seeker design. Their novel research in an optical correlation concept will be handed off to developers in order to complete a prototype optical correlation seeker for missiles and they will complete proof of concept experiments and acquisition of a data base for low dipole moment lasers and induced dipole lasers. These novel lasers will emit radiation in the far infrared region of the electromagnetic spectrum with potential for missile guidance or seeker applications. Electronic Warfare Laboratory will conduct research on electrogmagnetic wave propagation, antenna designs, and develop fundamental theory of behavior and control of sparse antenna arrays for ultra-, and very high frequency radio emitter location applications. New night vision and electo-optics research is reported in a separate descriptive summary. Their highlighted research topics for FY 1981 include imaging with uncooled detectors approaching the performance of the common

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module forward looking infrared device, a Schottkey barrier cadmium telluride detector for infrared radiation made by molecular beam epitaxy, the development of a smart sensor/autocuer performance model for target acquisition and tracking, an advanced bandwidth compression technique to be demonstrated by simulation, new laser designator materials for the mini-laser, and new near millimeter wave sources for fog, smoke, or foul weather penetration. Mobility Equipment Command laboratories plan to investigate immunochemical techniques for trinitrotoluene (TNT) detection, to develop new fibrous materials to reduce the heat emission of camouflage materials making them less detectable to heat seeking optics, and to investigate mechanisms of chemical conversion of fuels in fuel cells. Natick Laboratories will conduct nutrition research with limited animal feeding experiments, continue their development of analytical methods to discriminate among food components which influence wholesomeness and sensory quality of foods, and continue experiments in food microbiology and food acceptance. Other work will involve basic research in molecular changes in cotton materials to provide better protection against microbial degradation and effects of low- and high-energy lasers upon clothing and camouflage for textile materials. The Corps of Engineers' laboratories will formulate more economical geophysical methods for defining deep foundation conditions for hardened military facilities, determine explosive effect equivalence of bare charges versus cased munitions and finalize computer models for predicting tracked vehicle performance in various terrains. Research engineers in military construction will complete and validate their modeling techniques to show the effects of changes in construction process on the final structure; these effects include cost, strength, utility energy consumption, and factors which predict the transfer of impulse noise in military structures. The Cold Regions Research and Engineering Laboratory will continue to extend our knowledge of snow, ice, and frozen ground and their effects on mobility operations and installation construction. They will develop simulations of climate and ice conditions applicable to northern NATO countries and Canada. Current planning includes the conduct and support of field research exercises in northern Vermont which simulate winter battlefield conditions in order to examine weapon targeting capabilities. Research efforts in geodetic, geographic and mapping sciencies will lead to a broader data base for application of theories, concepts, and methodology toward solving military topographic problems. The rapid geodetic survey system will be tested in conjunction with a gravity gradiometer in order to check and increase the accuracy of collected data. Researchers will develop concepts for using spectrum analyzers to extract terrain features from aerial photography and complete a compilation of basic imagery landforms, drainage, and erosion indicator sets. Scientists at Atmospheric Sciences Laboratory will continue their outstanding work in experimental and theoretical modeling of formation and growth of dust clouds formed on the battlefield from mobile equipment and shell bursts. Future work will also include interpretation of remote wind sensing; a determination of obscuration effects in European and Middle East environments; improvement of dust measurement techniques; measurements of absorption, scattering and transmission of infrared and near millimeter wave lasers through "dirty" battlefield atmosphere; and characterization of meteorology encountered by long-range, high-altitude artillery and missiles. Research in Military Diseases, Injury and Health Hazards is reported in a separate descriptive summary (BS10). This new project is comprised of

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seven previous projects BS01, BS02, BS03, BS05, BS06, BS07, and BS08 and a part of A71A. This program will provide a data base in biophysics and biomedicine to reduce casualties, minimize the effects in injury, prevent or treat infection and disease, maintain performance levels, shorten recovery periods, and generate information on recovery from injury. Research in pollutants will continue with the development of short-term in-vivo carcinogenesis tests and initiation of studies of behavioral toxicology. At the Chemical Systems Laboratory, research will continue to refine amplified indirect virus detection methods for threat chemical warfare agents, and to investigate new methods for decontamination of chemical agents both by chemical means and by laser-induced chemistry. Work on the optical obscuration properties of smokes and fiber chaff materials will continue in an effort to discover all-wavelength and specific wavelength tailored smokes and obscurants. Human Engineering Laboratory will complete an assessment of "real-time-for-task" accomplishment of nuclear, biological, or chemical warfare battlefield decontamination. They will conduct an investigation of the relationship of stress and hormone cycles in the performance of military tasks and continue to address the subject of linguistic awareness in text and pattern resolution. They will also validate computational models for hearing in the presence of various kinds of noise and acoustic barriers, and expand long-term soldier performance experiments to include an examination of individual difference variables. A major thrust area in human factors of man-machine communication will be initiated with emphasis on underlying conceptual problems in information processing systems. Two efforts relating to human factors in field operations will come to completion: (1) recall of spatial cartographic information, which will contribute to understanding navigation research, and (2) research on the effects of task inherent demands, which will provide critical data for understanding and improving, continuous operations under field conditions. An investigation of the effects of feedback on organizational process will be completed yielding data on different systems available to, and suitable for use in, operational Army situations. Research on manpower and training requirements for complex systems will continue. This program element supports 1800 in-house personnel (1000 professional and 800 support personnel).

4. (U) FY 1982 Planned Program: The mainstream of this program will be to continue to supply fundamental data, theory, and experimental support to a wide range of developmental efforts in the Army including: combat vehicles, engines, armor, fuels and lubricants, energy utilization, munitions design, low-vulnerability explosives and propellants, more effective warheads, kinetic energy armor penetrators, nuclear armanents, fire control, small arms and small arms ammunition, communications, electronic warfare, computers, lasers, laser guidance, fuzes for artillery and missiles, radar, millimeter waves, night vision, photography for reconnaissance, camouflage, batteries and fuel cells for electric power, missile propulsion, guidance and control, mines and mine detection, food, clothing, chemical/biological warfare defense, new smokes, medical support, disease prevention, burn treatment, helicopter design-structure-performance, building construction, protective shelters,

fortifications, optimization of the man-machine interface, training methods and effectiveness, real-time position location, and tactical mapping. A vigorous extramural program in basic and applied research in mathematics, electronics, mechanics, aeronautics, metallurgy, materials, physics, chemistry, biology, and geophysical sciences of Army-wide interest will also be pursued in support of these programs.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #AH43 Title: Research in Ballistics
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) 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. (U) 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 the Office of the Secretary 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 program element 6.11.02.A research projects and titles: AH60, Research in Large Caliber Armament; AH61, Research in Fire Control and Small Caliber Armaments; and A71A, Research in Defensive Systems for Chemical Warfare/Biological Warfare. The project is also closely coordinated with project AH80, Ballistics Technology in program element 6.26.18.A and with portions of the Army Research Office program supported under project BH57, Research in Scientific Problems with Military Applications in program element 6.11.02.A.

C. (U) 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 contractors are Lawrence Livermore Laboratory, Livermore, CA; Paul Gough Associates, Portsmouth, NH; Naval Weapons Center, China Lake, CA; Calspan Corporation, Buffalo, NY; and Dyna East Corporation, Philadelphia, PA. Fifteen additional

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contractors will receive approximately $480,000. Direct Support to Research in Ballistics is also rendered through the Army Research Office under project B157, Research in Scientific Problems with Military Applications.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Preliminary strand burner measurements with a high density propellant sample indicate a transition to super-high burn rates above some critical pressure similar to that previously observed with low density propellant samples. Lithium borohydride appears to dramatically accelerate the combustion rate of a sample nitramine propellant powder, suggesting the possibility of an effective catalyst for nitramine propellants. Work in the projectile launch environment has produced a sub-model which accurately predicts the pressure distribution and efficiency of a muzzle brake component. In computational fluid dynamics, a two and three dimensional grid-generator has been completed and is operational. Gained a theoretical understanding of the effect of pressure on frictional ignition. Identified the crucial roles of pressurization rate and surface composition on ignition by compressive heating. Enhanced capability to predict long stand-off shaped charge performance through developing methods to handle particulated jets. Developed enhanced capability to optimize fragment warhead design and maximize target kill probability based on vulnerable area information of targets. The physical mechanism responsible for blast wave attenuation has been identified. Measurements of rod strain and pressure and rate of penetration in the target have been made on identical configurations. A new start scientific area analyized the magnetic origin of the low frequency signal from a gun, and the phenomena associated with millimeter wave signatures and background. The feasibility of super-fast-burn-rate propellant impulse generators as a guidance mechanism has been analytically studied with good agreement with measured data indicating a promising area for advancement of the state-of-the-art. Modification of an air defense fire control predictor incorporates position knowledge of the defended target thus permitting tracking and attacking an aircraft early in its attack phase.

2. (U) FY 1980 Program: Extend limited models of interior ballistics to a total parameter model and apply to three traveling charge concepts to test accuracy. Apply scale modeling concepts and developing theory to muzzle blast overpressure and acoustic problems of the projectile launch environment to assist in resolving artillery crew over pressure problems. Determine the mechanisms of explosive reaction, initiation and propagation in explosives for assessment of combat and transportation hazards and new insensitive explosives. Link a graphics system to the present structural response digital output to visualize three dimensional deformation processes. Apply the results of the signature subtask to conventional armaments to identify methods for reducing, subduing or abating present gun signatures on the battlefield. Initiate research in nonparametric statistics and robust statistical methods. Expand present stochastic differential games to multiple player force-on-force simulations. Investigate a family of robust lead predictors for tank fire control based on actual and synthetic maneuver models.

Project: #AH43 Title: Research in Ballistics
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

3. (U) FY 1981 Planned Program: Complete traveling charge concept feasibility effort. Utilize previous year muzzle blast/acoustical sound evaluation results as a base to evaluate concepts for altering or mitigating acoustic problems at gun crew stations. Apply developed theory to predict flight characteristics and performance of liquid-filled projectiles. Model transient effects of shaped charge jet formation and penetration. Evaluate high explosive compositions offering greater safety with performance equal to current explosives. Determine thermomechanical response of impacted armor and the response of long rod penetration during impact. Identify concepts for mitigating the effects of obscurants and natural background clutter on target signatures. Support joint electro-magnetic rail gun test and analysis of alternative weapons concepts. Complete theoretical investigation of fundamental two phase interior ballistics and corner flow concepts. Design, construct and fire a sabot seal projectile gun using low molecular weight solid propellants. Generate analytical guidelines for controlling instabilities associated with liquid propellant gun firings. Stability models for projectiles with novel internal payloads will be improved and application for a gyroscopic flight simulator substituting for actual flight tests will be evaluated. Work on initiation mechanisms will continue with emphasis on: friction and extrusion; understanding the pressure rise time effect on ignition; underatanding how the mechanized properties of the explosive affect the various ignition mechanisms; and understanding the mechanisms leading to sympathetic detonation in stacked munitions. Consider advanced high explosive/metal geometries for producing enhanced jet properties. A scaled-down prototype impulse generator model will be constructed and tested. Robust tracking/lead prediction for tank fire control will transition to exploratory development and beyond. Studies of distributed preprocessing for multiple sensor fire control will begin. Improve conceptual designs of smart bullets for air defense and antitank roles. This program supports 108 in-house personnel (81 professional personnel and 27 support personnel).

4. (U) FY 1982 Planned Program: Develop the mathematical description of in-bore transverse motion of dynamically stable or marginally stable projectiles. Analyze the mechanical behavior of nylon rotating bands and scientifically describe despinning bands for design concept evaluation. Apply these concepts to decrease hazzards to gun crew from muzzle blast overpressures. Develop and evaluate aerodynamic concepts for hollow projectiles. Incorporate target and fragment breakup concept results into penetration descriptions and integrate these into present vulnerability/lethality evaluation methods. Assess the characteristics of insensitive explosives to determine capabilities/limitations. Determine effects of adverse environment and countermeasures on millimeter wave target signatures. Demonstrate electromagnetic propulsion system selected from previous concept evaluations. Analyze results from scale prototype impulse generator. Exploit/transfer stochastic differential game technology. Initiate research in multivariate statistics.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable

Project: #AH43 Title: Research in Ballistics
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	6400	6822	7400	8500	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	6486	7290	8050	-	Continuing	Not Applicable

The $86 difference in FY 1979 is due to the reprogramming of funds to project BH57. The $468 difference in FY 1980 is due to the Congressional reduction in program element 6.11.02.A ($400) and the Congressional directive to reduce service support contracts ($68). The $650 difference in FY 1981 is due to a change in accounting proceedures for overhead/support costs at Aberdeen Proving Ground.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #AH45 Title: Air Mobility Research
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This project supports research to advance the state-of-the-art in rotary-wing aerodynamics, structures, propulsion, mathematical models, and avionics. 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 are being investigated and fracture control procedures and techniques are being developed. Propulsion research is 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 is developing mathematical techniques applicable to problems associated with air-mobility research. Avionics research will be aimed at reducing the proliferation of visual displays in helicopter cockpits and enhancing the capability to maneuver safely at nap-of-the-earth altitudes.

B. (U) 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 interservice 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 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. (U) 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; Langley, VA; and Ft Monmouth, NJ. Much of this work is performed jointly with NASA Research Centers at the first three locations. The top five contractors are: Bell Helicopter Textron, Ft Worth, TX; Dynamic Engineering, Inc., Newport News, VA; Material Science Corporation, Blue Bell, PA; Lockheed Georgia Company, Marietta, GA; and Spectron Development Laboratory, Mountain View, CA. The remaining contract program will involve twenty contractors for a total of approximately $1,500,000.

Project: #AH45 Title: Air Mobility Research
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: A family of airfoils for use on the advanced attack helicopter has been designed and fabricated, they are currently undergoing tests. Several generalized fuselage shapes were tested in the wake of separately-mounted rotors and the rotor wake geometries were measured using a laser velocimeter. Testing of a strike configured remotely piloted vehicle in the Langley wind tunnel was completed. Experimental oscillating airfoil measurements of dynamic stall characteristics of six helicopter airfoil sections have been completed. Theoretical results have provided a clear understanding of blade acoustics and a sound mathematical basis has been developed for the study of rotary-wing acoustic problems. Research on low-cost techniques for sintering complex shapes was initiated. A turbine blade formed from silicon nitride retained its original contours when sintered at 1850 degrees centigrade - an important advance toward making ceramic turbine blades a viable engine component. A joint Army/NASA program to investigate fuel injector types in small, reverse-flow combustors was conducted. Several fuel injector types were tested. Several premixed, prevaporized combustor concepts were designed. Results which improve state-of-the-art have been published. Evaluation of long-term environment effects on composites via helicopter flight service programs has been expanded in order to reduce the risk of short airframe lifetimes on future systems. A major new contracted program has been initiated in this area. An experimental program has been completed to investigate the impact resistance of hybrid composite materials in order to reduce the risk of higher maintenance costs in future systems. Initial methods have been developed and verified for predicting the fatigue life of composites thus permitting structures to be designed to higher standards of structural integrity. A three-dimensional steady lifting code has been developed with incorporation of a simple wake vortex interaction; and a three-dimensional nonlifting code extended to compute lift variations on a blade with arbitrary geometries has been developed. A mathematical basis for project selection policy under a fuzzy environment has been formulated.

2. (U) FY 1980 Program: Testing of the advanced utility helicopter (UH-1H) rotor blade in a wind tunnel is being completed. This data will be used to substantiate the blade/airfoil design process and will provide additional insight into the effect of airfoil/planform interactions on rotor performance. A major program definition and planning effort is being initiated in the area of rotorcraft wake modeling. Understanding of the rotor wake and its influence is fundamental in solving problems in performance, loads and vibrations, and handling qualities. The techniques developed to couple rotor design variables to the high-speed acoustic emission is being expanded to treat the blade vortex interaction noise. This will allow a more detailed understanding of rotorcraft acoustic signatures. As a follow-on to the flair analysis, development of the general rotor aeroelastic stability program (GRASP) for coupled rotorbody aeromechanical stability including a more accurate representation of blades, pylon, and fuselage is being initiated. This will provide for a more realistic structural model of the rotorcraft. The analysis of the simple one-on-one air-to-air combat problem is being completed. Efforts are being made to

Project: #AH45 Title: Air Mobility Research
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

incorporate helicopter characteristics and the nap-of-the-earth environment into air-to-air combat theories developed for fixed-wing aircraft. This will lead to design criteria for possible air-to-air combat helicopters. Silicon nitride research is expected to be completed; if successful it will provide the technology base for exploratory development of ceramic elements for Army gas turbine engines. Ceramic elements will allow higher operating temperatures and provide more efficient engines (lower fuel consumption) and reduce the requirements for critical materials. Research includes completion of tests with two 6:1 pressure ratio, swept-back bladed centrifugal compressors to determine the effect of a splitter between the blade rows. One compressor has splitters warped in the leading edge region to achieve an equal flow split between passages. Research includes an analytical correlation of radial turbine rotor losses as a function of stator setting angle to upgrade loss models for radial turbine design, comparison of analytical and experimental temperature predictions of a full-coverage film-cooled flat plate, and tests of contoured end wall stators. Newly-developed crash energy absorption tests are being used to generate data for input to computer analysis programs for helicopter crash survivability predictions. The objective of this current work is to improve occupant survivability in helicopter crashes. The program for the evaluation of long-term environmental degradation of composite materials by means of helicopter component flight service evaluation is being expanded. This work will contribute to the safe life and durability of future helicopter fleets. A new design of a small, high-speed, structural computer is being scaled up to the point where it can be used to solve small stress problems. This concept has future application as an on-board computer for structural integrity computation and more efficient maintanance scheduling. An experimental study of the effects of inadvertent machining flaws around holes drilled in composite structures will be completed and reported. *This work will help establish adequate inspection criteria.* A study program to identify the most likely composite helicopter fuselage design concepts for the 1990's is being initiated. This will help plan future research programs. Effort is being devoted to develop an optimal fault-isolation technique based on the result of work performed by Professor William S. Jewell and his associates at the University of California (Berkeley) under Army Research Office sponsorship. Development of a small-disturbance code to predict the full three-dimensional unsteady flow field on an advancing blade with time-varying lift will begin and the successful completion of this task should mark the beginning of detailed design studies (with the active participation of industry).

3. (U) FY 1981 Planned Program: The results of the utility helicopter (UH-1H) scale-model rotor tests will be analyzed to determine what changes are required in the design process in order to maximize performance improvements. The development of an improved mathematical model for rotor wakes and numerical calculation methods will be continued, guided by experimental results and by the requirements of industry. The rotary-wing acoustic research program will continue to define the effects of rotor blade design on noise signatures. Advanced structural dynamics analysis methods will continue to be explored with particular emphasis devoted to nonlinear finite-element analysis of bearingless rotor blade configurations. Analytical techniques to study multiple air-to-air combat engagements will be completed and exercised to develop some basic understanding of the

Project: #A1145 Title: Air Mobility Research
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

trade-offs involved in designing rotorcraft for such a use. Compressor Design Model research will include assessment of the effects on performance of varying impeller diffusion rates by varying impeller blade height. From analysis and test assess the potential of various vane and pipe diffusers for improving compressor performance. A comprehensive design model for radial turbines using latest available loss models will be initiated. The study of end wall stator configurations on turbine performance will be completed. A fatigue life theory for composite laminates that includes both tension and compression load cycles will be formulated and programmed for computation. This will assist in predicting the life of airframe components. Initial wearout and maintenance data from the various programs on flight service evaluation of composite helicopter components will begin to become available at regular intervals. This data will eventually establish reliable life prediction and maintenance costs for composite hardware. An experimental program to characterize the post-buckling fatigue limits of composite panels in helicopter fuselage applications will begin. This task will provide needed preliminary design data to the technical community. A study program to establish the long-term direction of future research on composite helicopter fuselages will be completed and published. A program for efficiently and reliably fabricating heavy fuselage frame members from composite materials will be completed. Efforts will be devoted to refine the optimal fault-isolation technique for diagnostic analysis. The complete small-disturbance rotor code modeling of all irrotational physical effects will be completed. Much effort will then be put into comparing these solutions with experimental data and detailed design and optimization techniques using this code. Also, a two-dimensional code with complete boundary or a three-dimensional code with linearized boundary will be undertaken. The proliferation of visual displays in typical helicopter cockpit environment has reached the point of diminishing return for visual stimuli. The potential of transmitting flight information to the pilot via nonvisual sensory channels; e.g., kinesthetic - tactual sensory channel, will be investigated. Investigations of the electrical characteristics of composite material airframes with emphasis on understanding the effect on aviation electronics will be initiated. This project will support 140 in-house personnel (75 professional personnel and 65 support personnel).

4. (U) FY 1982 Planned Program: Airfoil development for specific blade geometries, planform and mission will continue based on prior year results. Rotor wake theoretical and experimental efforts will be increased with the objective of providing greater understanding of the interaction between acoustics, dynamic stall, and transonic effects. Data will be developed to provide design and noise prediction information for industry use in rotor noise reduction methods. The GRASP analysis will be extended to forward flight. The potential of new concepts will be assessed by actively varying the clearance of centrifugal impellers to improve performance. A test program will be initiated in the single-stage compressor facility. The comprehensive analytical design model for the radial turbine will be completed. The structures research effort will emphasize long-term durability of composites, formulation of an adequate structural integrity-basis for composite materials, improved design-analysis/methods, improved crashworthiness capability, and vibration reduction through improved understanding of structural parameter influences. Application of optimal fault-isolation technique to a selected model will be commenced.

Project: #AH45 Title: Air Mobility Research
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

Relaxation of the small-disturbance and inviscid approximation on the transonic equation will be continued. Fundamental aviation electronics research in areas that will enhance mission capability, safety and performance will be continued.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable.

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	5355	5745	6750	7800	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	5365	6000	6400	-	Continuing	Not Applicable

The $10 thousand reduction in FY 1979 was due to a minor reprogramming within the program element. The $255 reduction in FY 1980 was due to the Congressional reduction in this program element ($250) and the Congressional directive to reduce travel ($5). The $350 planned increase in FY 1981 is for the purpose of initiating a new effort in avionics to enhance helicopter mission capability, safety, and performance.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #B157 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) 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 scientific base for subsequent exploratory and advanced developments in Defense-related technologies and for new or improved military functional capabilities in areas such as communications, detection, tracking, intelligence, surveillance, air defense, weapons, munitions, aircraft, missiles, propulsion, land vehicles, guidance and control, navigation, energy conversion, materials, armor, structures, military construction, and personnel support. The Physics, Chemistry, Mathematics, Materials, Electronics, and Mechanics and Aeronautics programs are described in separate descriptive summaries. Atmospheric research provides the technology necessary to delimit weather degradation of weapon systems utilizing a wide range of the electromagnetic spectrum. Terrestrial research is concerned with investigating earth surface and sub-surface conditions and with remote sensing of those conditions relevant to military mapping and to assessment of limitations to mobility and construction. Biological sciences research in such areas as biochemistry and microbiology supports development of an adequate defense capability against chemical and biological weapons, contributes to reduced costs through increased lifetime of materiel and protection of subsistence items, lessens the impact of Army activities on natural environments, improves morale, and increases effectiveness of the soldier. This project is divided into scientific areas as follows: 01-Atmospheric and Terrestrial Sciences; 02-Biological Sciences; 03-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. (U) RELATED ACTIVITIES: This is primarily a contractual program. It 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 that there is no unnecessary duplication is accomplished by program reviews; exchange of program information, research and technology resumes and technical reports; interservice and interagency liaison; and attendance and participation of Army representatives at annual reviews held 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 the scientific literature.

Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

C. (U) WORK PERFORMED BY: This program of grants and contracts with academic and not-for-profit institutions and industrial laboratories is managed by the US Army Research Office, Research Triangle Park, NC. The top five contractors are: Massachusetts Institute of Technology, Cambridge, MA; Stanford University, Stanford, CA; University of Wisconsin, Madison, WI; Columbia University , New York, NY; and Stanford Research Institute, Menlo Park, CA. There are in addition approximately 250 grantees and contractors. The value of the additional grants and contracts is $32,000,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: A high resolution spectrometer was developed and flown on a satellite, and measured a surprisingly rich line spectrum in the extreme ultraviolet part of the electromagnetic spectrum adding to our knowledge of the physics of upper atmosphere. A new method of remotely measuring cross winds using dual parallel low power laser beams has been developed which has implications for fire control and smoke/obscuration. The capabilities of a two-wavelength lidar system for quantitative observations of tactical smoke and dust clouds, and for estimating electromagnetic transmission through smoke and dust clouds from backscatter measurements have been demonstrated. Values of the complex refractive index for 30 smoke and combustion products were measured over the wavelength range 2-33 microns. Cross-correlation techniques developed for stereo image pairs have resulted in improvements in the automation of the map making process. A volumetric constitutive law for snow has been formulated and applied to the analysis of the effectiveness of mine and counter-mine systems in snow-covered terrain, and of the effectiveness of explosives in triggering snow avalanches. Work on mechanisms by which bacteria control synthesis of botulinum toxins will lead to faster techniques for food safety analysis and prevent toxin formation in improperly handled foods. New equipment and techniques were developed for measurement of electrical properties of living tissues in man and animals. These techniques will be important in establishing acceptable exposure levels for microwave radiations (including radar) and combined stress or drug and radiation effects. Accomplishments under the Electronics, Materials, Mathematics, Mechanics and Aeronautics, Physics and Chemistry programs are reported in separate descriptive summaries.

2. (U) FY 1980 Program: The program is balanced between research responsive to a stated need or which supports ongoing programs in Army laboratories, and high-risk work with the potential of long-term contributions to future Army technologies. The Electronics, Materials, Mathematics, Mechanics and Aeronautics, Physics and Chemistry programs are reported in separate descriptive summaries. Work in the Atmospheric and Terrestrial Sciences includes cloud and aerosol physics and atmospheric effects on electrooptical transmission; atmospheric sensing and probing; smallscale atmosopheric processes; earth material properties and fluid dynamic processes; and remote sensing and mapping of the terrain. Work in the Biological Sciences includes defense against biological warfare and control of pests that damage stored products.

Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

3. (U) FY 1981 Planned Program: The FY 1981 program will be a continuation of the work described in Section 2 above. A balance will be maintained between long-term basic research and research with potential for near-term payoff. Planned programs for the Electronics, Materials, Mathematics, Mechanics and Aeronautics, Physics and Chemistry programs are reported in separate descriptive summaries. Work in the Atmospheric and Terrestrial Sciences will include: The effects of fog, falling snow, dirt and dust upon the transmission and imaging properties of electromagnetic waves; the evaluation of techniques to account for multiple scattering and scattering from non-spherical particles; and the physics of time-dependent water movement in soils leading to the development of soil moisture predictive models. Work in the Biological Sciences will include research on non-cholinergic nerve impulse transmitters potentially involved in non-lethal incapacitation of man, and the protection of packaged products from pest attack. Personnel involved in support of this project include 29 professionals and 67 support for a total of 96.

4. (U) FY 1982 Planned Program: The FY 1982 program will be based on a continuation of the work described in the foregoing sections and that which is described in the separate descriptive summaries mentioned above. The flexibility to initiate new thrusts as promising scientific areas and corresponding Army needs become evident will be maintained.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable.

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	31213	38608	49000	60500	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	31950	38646	50980	-	Continuing	Not Applicable

Prior to FY 1979 the management and support costs for operating the Army Research Office were paid from the program element 6.58.01.A, Programwide Activities. For FY 1980 and future years these management and support costs will be paid from BH57 funds. The funding figures above were restructured to include the management and support costs for all four fiscal years

Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
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including FY 1979. The reduction in FY 1979 between planned and actual reflects the fact that inadequate funds were provided from 6.58.01.A to cover the management and support costs. Actually, only $2352 were transferred, rather than the expected amount of $3450. This deficit was reduced from $1098 to $737 by reprogramming $361 from other 6.11.02.A projects into BH57. Finally, the "FY 1979 Actual" figure reported above is correct, even though it is $1106 higher than the figure reported in the project listing displayed as part of the program element 6.11.02.A Congressional Descriptive Summary. This difference is due to the fact that a recent report submitted by the Army reported only the transfer of $1246 from program element 6.58.01.A rather than the actual amount of $2352. The correct funding of project BH57 for FY 1979 is used above, whereas the smaller amount of $30107 is used in the 6.11.02.A program element Congressional Descriptive Summary so that the total funding of the program element is consistent with the incorrect recent report. The reduction in FY 1980 was made in response to the Congressional directive to reduce travel and overtime. The reduction of $1980 in FY 1981 reflects a reduction in funding for program element 6.11.02.A and a minor change in emphasis.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #03 Title: Electronics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The electronics scientific area contributes to the technology base through the exploration of novel phenomena 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 and other planning 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 US Army Research Office 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. (U) RELATED ACTIVITIES: This program is related to parts of the following projects in Program Element 6.11.02.A: AH43, Research in Ballistics; AH44, Research in Fluidics, Nuclear Effects and Ordnance Electronics; AH46, Research in Combat Surveillance and Target Acquisition; AH47, Electronic Devices Research; AH48, Electromagnetic Propagation and Antenna Research; AH49, Missile and High Energy Laser Research; AH51, Combat Support Research in Electronic Warfare; A31B, Night Vision and Electro-optics Research; and B53A, Research in Atmospheric Sciences. 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. (U) 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; Georgia Institute of Technology, Atlanta, GA; Stanford University, Stanford, CA; the University of California, Berkeley, CA; and Columbia University, New York, NY. The total number of additional contractors is 39; the total dollar value of these additional contracts is $3,240,000.

Technical/Scientific Area: #03 Title: Electronics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Significant accomplishments resulting from the electronics research program which are having an important impact on Army systems are described here. A totally new theoretical approach for the calculation of stress distribution and aging in quartz crystal plates has been obtained which will permit further drastic improvements in oscillator long-and short-term stability; the predicted hundred fold oscillator stability improvement will impact on the accuracy of location and velocity determination of missiles, Global Positioning System (GPS), Joint Tactical Information Distribution System (JTIDS), and Single Channel Ground and Airborne Radio System (SINCGARS). A highly promising, innovative method has been developed to obtain atomically clean silicon surfaces; this will lead to novel electron devices such as wide-gap-emitter bipolar transistors, and field effect transistors with greatly reduced noise figure. A rigorous, network-based technique which allows one to analyze complex, low-profile antenna systems has been developed. An understanding of printed circuit, planar antennas has been achieved. Sensitive, high-speed, room-temperature detectors suitable for focal plane arrays for far infrared systems which may be manufactured using Integrated Circuit (IC) techniques have been developed, and this technology is being transferred to Army laboratories. Design techniques for monolithic, high-precision Metal Oxide Semiconductor (MOS) switched capacitor ladder filters as large-scale integrated circuit elements have been developed. Significant progress has also been made in the area of two-dimensional (2-D) signal processing. A technique called hexagonal sampling has been developed for 2-D signals which results in significant reduction in computation and storage. Numerical optical processors have been designed which perform Boolean logic operations between large 2-D arrays of binary numbers in only a few billionths of a second. Research conducted in this program has also resulted in the development of realtime automatic television target tracking instrumentation at White Sands Missile Range. The system will eventually replace the existing motion picture tracking system which requires post-test, labor-intensive film analysis.

2. (U) FY 1980 Program: The FY 1980 program is addressing problems in six major areas of electronics research of major importance to the Army: physical electronics; electron devices; antennas and electromagnetic detection; circuits, networks, and related systems; signal processing, communications, and related systems; and computers and information processing. More than half the resources are being expended on topics in solid state electronics because of the critical requirements for reduction of power requirements and cost of electronic systems and for increased reliability and speed. A new program is being initiated to investigate topics in ultra-submicron electronic research. Emphasis is being placed on understanding the fundamental limits of submicron electronic devices and automated approaches to the design of circuits utilizing these devices, i.e. very large scale integrated circuits. Another area, in antenna research, which is receiving additional attention, relates to the design of conformal antennas for use on missiles and aircraft structures; progress is expected in understanding the

Technical/Scientific Area: #03 Title: Electronics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

characteristics of printed circuit antennas. Current programs in communications and signal processing are being continued at the same level of support since progress has been good in providing new technology base information useful to the Army in signal detection, target tracking and recognition, and digital communication. The Army's portion of the support of the Joint Services Electronics Program (JSEP) is $2.9 million of a total triservice effort of about $9 million. Universities now involved in JSEP are: Harvard University, University of Illinois, Ohio State University, Texas Tech University, Stanford University, Massachusetts Institute of Technology, Columbia University, California Institute of Technology, Georgia Institute of Technology, University of Southern California, University of Texas, Cornell University, University of California at Berkeley, and Polytechnic Institute of New York.

3. (U) FY 1981 Planned Program: It is expected that most of the FY 1980 program will be continued into FY 1981. The current electronics program continues to provide significant new results for Army systems and current and planned efforts are highly relevant to Army needs. During FY 1981 the ultra-submicron research efforts will be expanded with more emphasis on particular materials appropriate for use in very large scale integrated (VLSI) circuits. Efforts will also continue to understand better the techniques required for computer-aided or completely automated design of circuits having the complexity being projected for VLSI. Increased research effort will be expended to overcome existing barrier problems in electronics such as thorough understanding of novel semiconductor materials for extremely high frequency applications, novel active antenna principles, and the detailed understanding of surface and interface effects in solid state electronics. The investigation of these specific barrier problems will support the Army laboratories in meeting their objectives for more efficient and cost-effective electronic systems. In addition, emphasis will be placed on novel electronic systems for which operational capability objectives exist, but no active Army laboratory program has yet been initiated for lack of fundamental data. Specific basic research areas of interest are the field of night vision devices in the far infrared range, principles which govern generation, propagation, and detection of millimeter to submillimeter waves, and the related investigation of parameters of materials to be used in these applications. It is planned to provide additional funds for new research equipment in the JSEP. Personnel involved in support of this task include 4 professionals and 14 support, for a total of 18.

4. (U) FY 1982 Planned Program: The planned program for FY 1982 is a continuation of the effort described for FY 1980 and FY 1981. The direct support of US Army laboratories for advancing the state-of-the-art of military electronic systems and in solving existing barrier problems will be increased. This will result in a reduction in leadtime for systems development and at the same time, assure effectiveness with increased reliability. It is further planned to keep the laboratories informed about recent accomplishments of the basic research community so as to enable Army researchers to conceptualize novel electronic systems to be built on the basis of more detailed application-oriented research. In regard to specific thrust areas in which

Technical/Scientific Area: #03 Title: Electronics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
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funds will be expended, it is planned that the following research fields will receive first priority: millimeter and submillimeter waves, circuit integration, electronic materials, novel electronic engineering devices, communications in multisignal environments, distributed computer systems, and signal processing and information display.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: (Not Applicable)

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	6875	8255	10590	13040	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	6751	8169	10818	-	Continuing	Not Applicable

The funding differences between the FY 1980 submission and current requirements reflect minor changes in emphasis.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #04
Project: #BH57
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Materials
Title: Research in Scientific Problems with Military Applications
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The scientific area of materials contributes to the science and technology base through the investigation of relationships between the composition, structure, defects, processing, and useful properties of materials in order to help satisfy short and long-range Army requirements. In order to accomplish this objective, the aims are: to discover the relation between composition and structure of materials and the useful properties of those materials; to learn the principles whereby those properties may be dependably reproduced for application toward solution of Army problems, (e.g., improvement of strength and fracture toughness of materials of armaments, armor, aircraft, and vehicles; protection against degradation in service or storage; improvement of electric, magnetic and optical materials for communication, guidance and control, and for energy storage or transmission; and discovery of processing techniques that provide improved reliability of materials in components); and to develop simple, reliable, inexpensive procedures for testing and analysis of materials and components. The Army's FY 1980 Science and Technology Objectives Guide; frequent coupling with DOD laboratories and agencies, and other Federal agencies including the National Science Foundation, National Bureau of Standards, National Aeronautics and Space Administration, and the Department of Energy; participation in technical meetings; and foreign intelligence (provided through The Technical Cooperation Program and by the Foreign Science and Technology Center) assist in guiding the selection of topics to be supported in the program.

B. (U) RELATED ACTIVITIES: This program is related to parts of the following projects in Program Element 6.11.02.A: AF22, Research in Vehicular Mobility; AH42, Research in Materials and Mechanics; AH43, Research in Ballistics; AH45, Air Mobility Research; AH47, Electronic Devices Research; AH48, Electromagnetic Propagation and Antenna Research; AH49, Missile and High Energy Laser Research; AH51; Combat Support Research; AH52, Research in Support of Equipment for the Individual Soldier; AH60; Research in Large Caliber Armaments; and AH61; Research in Fire Control and Small Caliber Armament. Close coordination is maintained with the Navy, Air Force, Defense Advanced Research Projects Agency, National Aeronautics and Space Agency, Department of Energy, and the National Science Foundation. Coordination meetings are held on a regular basis (e.g., Interagency Materials Group).

C. (U) 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; Battelle Memorial Institute, Columbus, OH; University of Pennsylvania, Philadelphia, PA; Rensselaer Polytechnic Institute, Troy, NY; and Pennsylvania State University, State College, PA. The total number of additional contractors is 45. The total dollar value of these additional contracts is $4,040,000.

Technical/Scientific Area: #04
Project: #B157
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Materials
Title: Research in Scientific Problems with Military Applications
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Significant progress has been made in synthesis and processing, reproducibility and reliability of materials, and in understanding the underlying phenomena upon which these achievements have been based. During the past year, new nondestructive evaluation techniques using lasers and high intensity light emitting diodes have been developed to detect flaws and degrading moisture in polymer matrix composites, which are employed in helicopters and other lightweight mobility applications. A novel method for production of amorphous powders during slow cooling from highly undercooled molten droplets has been developed by immersing the metal in inert emulsions, and the contractor has demonstrated the ability to consolidate the amorphous droplets into an amorphous compact by shear deformation. This accomplishment offers promise for a process to synthesize amorphous materials in bulk form, with precise control over subsequent microstructural and property development and for use in applications such as battlefield generators, transformers, motors and magnetic shielding. A new process, strengthening by fractional melting, has been developed with aluminum alloys for producing homogeneous, fine grained, high strength cast alloys with properties comparable to wrought alloys but without the greater number of processing steps required by other methods. This development could have widespread Army application in such areas as lightweight armor and lightweight bridging. A new method of processing metal-organic sols and gels allows the direct formation of monolithic ceramics from metal-organics with elimination of high-temperature powder metallurgy steps and has the advantage of high-purity chemical control. This technique has opened a new avenue for processing of ceramics. Materials produced by this technique have promise in Army applications including high temperature battery electrodes, fuel cell electrodes and feed throughs, optical wave guides, laser windows and laser host materials, and oxide passivation layers for integrated circuits. A recent accomplishment in the area of mechanical behavior of materials is the development of fracture mechanism maps for metallic alloys. These maps show the region of stress, time, and temperature over which a given mechanism of fracture is dominant (i.e., cleavage, ductile fracture, creep and rupture) and is sensitive to changes in alloy composition, microstructure, and heat treatment. Some potential applications include design predictions for ballistic penetrators and armor, structural durability and reliability for armored and personnel vehicles and aircraft, materials of construction, and optimized fragmentation for munitions. Research into fretting fatigue of steels, in which the environment and mechanical loading continue to cause premature failure in applications such as engine components and structural bearings, has shown the mechanism to be controlled by delamination, and that improved resistance to fretting should be approached through reducing susceptibility of the surface layer to cracking by using surface hardened or very soft layers.

2. (U) FY 1980 Program: A broad program of research into hot gas erosion relevant to critical degradation of gun tubes, turbine engines, and missile components was initiated during the FY 1978-79 period. Significant advances in mechanistic

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Project: #BH57 Title: Research in Scientific Problems with Military Applications
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understanding of hot gas erosion phenomena in hot, turbulent, reactive gas flows are expected this year, leading to potential avenues for protecting materials in future applications in which the temperature, pressure, and gas reactivity are projected to be much more extreme. Several areas are identified as special areas of interest owing to their importance to Army needs, their timeliness, and their potential for large payoff. One such thrust being initiated is the behavior of materials under high rates of energy impingement, e.g., ballistic shock and laser pulsing. Another area of program expansion is the tailoring of properties of materials through structural control; this thrust is concerned with providing knowledge of the fundamental relationships among materials synthesis, structure (electronic, morphological and defect) and properties, in order to form the basis for the discovery and development of novel materials to meet future needs. Examples of such research topics are: diffusion kinetics and annealing behavior of defects on the submicron scale (for submicron electronic devices) and novel (e.g., by intercalation) electronic, magnetic, and optical materials. Another area of emphasis for FY 1980 is nondestructive evaluation of materials and structures for assurance of reproducibility and reliability, e.g., composite materials and submicron electronic structures.

3. (U) FY 1981 Planned Program: The thrust initiatives of FY 1980 (behavior of materials under high rates of energy impingement, tailored properties of materials through structural control, and nondestructive evaluation) will continue to be emphasized. In addition, an initiative will be made in novel, nonequilibrium materials and structures, such as amorphous alloys, rapidly quenched fine powders, and ion implanted surfaces, which have potential advantages because of their magnetic properties for use in transformers and magnetic shielding, their mechanical properties and resistance to degradation at high temperatures (turbine applications), their improved corrosion behavior as coatings and surface treatments, and for improved wear resistance of surfaces. Another thrust will be in the area of environmental degradation of materials, directed toward improved mechanistic understanding and prediction of deterioration in service and in storage. Objectives of this research include the establishment of bases for the development of materials tests which simulate the critical factors responsible for deterioration of materials and more realistically predict actual behavior in service, as well as the development of new defenses (alloys, coatings, and storage conditions) against such deterioration. Personnel involved in support of this task include 4 professional and 8 support, for a total of 12.

4. (U) FY 1982 Planned Program: The thrusts initiated in the previous fiscal year will be brought to maturity. The total materials program will continue to be scrutinized to allow for incorporation of programs which offer opportunities based on new technologies and programs to form the basis of future technologies.

Technical/Scientific Area: #04 Title: Materials
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable.

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	3935	4870	6140	7590	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	*	*	*	-		

* A separate Congressional Descriptive Summary was not submitted on this scientific area in FY 1980.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #05 Title: Mathematics
Project: #B157 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: Objectives of this task are twofold. The first objective is to support the acquisition and systematic advancement of fundamental knowledge in the mathematical sciences relevant to future Army needs as well as those needs inherent in its present operations. Some of this knowledge will be applicable to such work as field and laboratory testing, mechanical design, fluid flow and information handling. This phase of the program is directed toward providing the mathematical foundation for treatment of both short- and long-range problems of interest to the Army. The dissemination to Army installations of research results obtained in the above program, coupled with advice and assistance, constitutes the other phase of the mathematics program. For example, to promote communication among Army scientists, there is a continuing program of three annual Army-wide conferences and a series of smaller, special purpose workshops. In addition, visits are made to Army installations by the investigators to brief personnel on recent mathematical developments. A program of tutorial and orientation lectures has been developed which emphasizes the presentation of mathematical techniques with Army utility. Mathematical results of foreign researchers are considered.

B. (U) RELATED ACTIVITIES: The Navy, Air Force, National Science Foundation and other goverment agencies and industrial groups conduct related research in the mathematical sciences areas. Coordination to assure no unnecessary duplication is accomplished by periodic interagency meetings, program review, exchange of program data sheets and technical reports, and attendance and participation of representatives at annual reviews sponsored by the Office of the Under Secretary of Defense for Research and Engineering. Coordination also occurs through sponsorship of meetings and conferences, attendance at professional and scientific society meetings and review of the scientific literature.

C. (U) WORK PERFORMED BY: This program of contracts is managed by the US Army Research Office, Research Triangle Park, NC. The top five contractors are: University of Wisconsin, Madison, WI; Stanford University, Stanford, CA; University of California, Berkeley, CA; Brown University, Providence, RI; and Carnegie-Mellon University, Pittsburgh, PA. There are in addition 85 contractors. The value of the additional contracts is $2,740,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: It has been increasingly recognized that most interesting physical phenomena such as occur in optics, communications, and solid state electronics are nonlinear. Therefore, methods which solve nonlinear systems exactly are constantly being sought. Recently, a new technique, called the inverse scattering transform, has been

Technical/Scientific Area: #05 Title: Mathematics
Project: #B1157 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

shown to provide exact solutions to certain equations, and an easily verified condition has been developed which determines if this method is applicable to a given problem. A major problem in image processing is the determination of edges or image boundries in complex and fuzzy images. A new technique has been proposed for such problems based on the principle of maximum likelihood estimation. This technique yields a practical scheme for automatic target recognition. With the advent of microprocessors and the possibility of placing these devices directly in military hardware, it becomes necessary to be able to predict in advance the accuracy of a given algorithm. A new concept of relative precision has been developed which allows a considerably simpler and more realistic estimation of initial accuracy requirements necessary to obtain final precision.

2. (U) FY 1980 Program: Research efforts relevant to the Army's mission are being supported in the four subareas of applied analysis, numerical analysis and computing, operations research, and statistics and probability. These investigations are motivated by such problems as heat conduction in weapons and other structures, by problems occurring in combustion and ignition, penetration mechanics, signal processing, fire control, guidance and control of missiles, reliability of complex weapon systems, and command and control; and by the need for a methodology to treat effectively Army operations research and logistics problems arising in design, development, testing, distribution, and support of weapon systems.

3. (U) FY 1981 Planned Program: In addition to pursuing the major directions in the present program, emphasis in FY 1981 will be placed on the solution of nonlinear time-dependent problems in mechanics and electronics, propagation through random media, mathematical software, and the development of fast algorithms and robust statistical techniques. Personnel involved include 4 professional and 10 support, for a total of 14.

4. (U) FY 1982 Planned Program: In order to improve the operational capabilities of the Army at an acceptable cost of materiel, it is desirable to intensify the exploitation of scientific advances and novel engineering concepts. In FY 1982, emphasis will be placed on software for microprocessors and on numerical methods for arrays of such devices. In addition, support will be increased for the development of algorithms for real-time control processing.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: (Not Applicable)

Technical/Scientific Area: #05 Title: Mathematics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	4303	5260	6520	8130	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	*	*	*	-		

* A separate Congressional Descriptive Summary was not submitted on this scientific area in FY 1980, since it was only after the management and support costs were included that this scientific area exceeded $5 million in FY 1980.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #06 Title: Mechanics and Aeronautics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This task covers the field of solid mechanics, fluid mechanics and power generation and has the general objective of establishing a technological base from which engineering design improvement can be made. Research supported in the discipline of solid mechanics includes structural mechanics and dynamics, fatigue and fracture mechanics, lubrication, friction and wear, vibrations and mechanism noise, response of materials and structures to impulsive loads, wave propagation, theory of machines, mechanisms and robotics, dynamics of composite materials, elasticity, viscoelasticity and plasticity. Fluid mechanics embraces such fields as wind tunnel testing techniques, boundary layers, turbulence, separated flow fields, dynamic stall, aerodynamics and fluidics. In the area of power, research includes investigations in combustion, engine concepts, fuel conservation, alternate and synthetic fuels, and weapon propellants and their theory of combustion and ignition.

B. (U) RELATED ACTIVITIES: This scientific area is related to the following projects in Program Element 6.11.02.A: AF22, Research in Vehicular Mobility; AH42, Research in Materials and Mechanics; AH43, Research in Ballistics; AH44, Research in Fluidics, Nuclear Effects, and Ordnance Electronics; AH45, Air Mobility Research; AH49, Missile and High Energy Laser Research; AH51, Combat Support Research; AH60, Research in Large Caliber Armaments; and AH61, Research in Small Caliber Armaments. Joint participation in conference sponsorship with other Defense services and other government agencies is undertaken, such as: the biennial meeting of the Heat Transfer and Fluid Mechanics Institute; the Golden Jubilee Meeting of The Society of Rheology; the Sixteenth Annual Meeting of the Society of Engineering Science; meeting of The International Union of Theoretical and Applied Mechanics (IUTAM); and the IUTAM Symposium on Finite Elasticity. These joint programs are directly coordinated with administrative counterparts in other Department of Defense (DOD) agencies. Army arsenal and other DOD scientists participate in and attend these meetings at no fee and several copies of the proceedings are received for internal Army library distribution. In addition, workshops addressing specialized technical topics are jointly sponsored with Army laboratories or arsenals, such as: Engine Combustion, Emergency Processing of Fuels, Shock-Boundary Layer Interaction, Unsteady Turbulent Boundary Layers, Mechanical Behavior of Tank Pads and Tracks, Operational and Design Constraints as a Result of Lubrication, Stability and Dynamic Response of Rotors and Squeeze Film Bearings, Rotor Dynamic Instability Problems, and Theory of Machines and Mechanisms. The mechanics and aeronautics program of the Army Research Office is presented and reviewed along with those of the Navy and Air Force at annual reviews of the DOD programs in materials, mechanics, structures and aerodynamics. Annual assessment reviews provide a forum for direct exchange of technical information regarding projects of common interest, progress in specialized technological areas and identification of research results having possible application to Army problems. A contract with Stanford University on unsteady turbulent boundary layers is being jointly supported with the National Aeronautics

Technical/Scientific Area: #06 Title: Mechanics and Aeronautics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

and Space Administration - Ames Research Center and the Research and Technology Laboratory of the Army Aviation Research and Development Command. Another project at Nielsen Engineering and Research, Inc., concerned with the aerodynamics of missile wings is being jointly supported with the Army Missile Command and the Naval Air Systems Command. In both cases, coordination is accomplished by shared technical monitorship over the contract and by distribution of reported data to all agencies concerned.

C. (U) WORK PERFORMED BY: This program of contracts is managed by the US Army Research Office, Research Triangle Park, NC. The five top contractors are: Princeton University, Princeton, NJ; University of Illinois, Urbana and Chicago, IL; Massachusetts Institute of Technology, Cambridge, MA; Northwestern University, Evanston IL; and Rensselaer Polytechnic Institute, Troy, NY. The number of additional contractors is 49. The total dollar value of these additional contracts is $4,680,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: An Army supported research program at the University of Cincinnati concerned with particle dynamics and erosion in turbomachinery has greatly contributed to our knowledge of the entire turbine erosion problem area. This body of knowledge has provided the necessary technology for, and is being used in, ongoing investigations at Westinghouse Electric Corporation, Pratt & Whitney Aircraft and the General Electric Company. More recently, extensive erosion problems on the T-700 engine on Army helicopters operating in dusty environments have prompted extreme interest in these research results. An Army research project at Stanford University on the frictionless sheet extrusion problem obtained a solution for various boundary conditions which arise in metal-forming operations. A finite element formulation in a variational form was used for frictional tractions at the boundary in this research project. The higher order theory for the motion of a viscoelastic fluid between concentric rotating cylinders obtained on an Army project at Lehigh University, has predicted the shape of the free surface of the fluid. These results agree with another Army experimental investigation of the same phenomenon conducted at the University of Minnesota. Power engine research supported by the Army has resulted in development of cycle simulation methods and programs widely used by the engine industry. New techniques developed on an Army project for measuring heat transfer, combustion rates and emissions in diesels are being used by industry in both engine design and in evaluating existing models.

2. (U) FY 1980 Program: The FY 1980 research program represents a logical and integrated continuation of the FY 1979 research program with shifts within certain technological problem areas to reflect increasing concerns about specific

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Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

operational requirements. For example, for rotorcraft aerodynamics, there is a general shift of emphasis away from unsteady separation and aeroacoustics to rotor wakes, especially in ground effect, to transitional rotor flight regimes and to flows exhibiting separation and stalling characteristics. Significant gains are being made in understanding the aerodynamics of rotor blades in nap-of-the-earth environments. Research investigations pertaining to gun launched projectiles are placing more emphasis on unsteady or dynamic effects and hypersonic conditions. An efficient and cost effective engineering analysis tool for projectiles in transonic flight is being completed. More support is being given to propulsion aerodynamics particularly with respect to flow in radial compressors and turbines. The interaction of shear and compression shock waves are being investigated experimentally to evaluate the interaction process. In addition, the frictional forces between target and projectile are being investigated for oblique loading. A comprehensive tribological program has been initiated at Rensselaer Polytechnic Institute which encompasses efforts in mechanics, chemistry and materials for an interdisciplinary analysis of friction, wear and lubrication. In the power program, emphasis is being given to the chemical reactivities of engine fuels and their species identification. Multi-fuel capability of engines is being addressed so as to permit combat vehicle operation in combat zones on minimally refined fuels. Research is continuing on liquid propellants for performance improvement over solid propellants for hypervelocity guns.

3. (U) FY 1981 Planned Program: The research program for FY 1981 will be a continuation of the FY 1980 program described above. Increases in planned funding will be used to support needed research in several new areas. The research effort on small gas turbine engines begun in FY 1980 will be greatly expanded in FY 1981 concentrating on such problems as compressor-diffuser interfaces, turbine blade cooling, variable geometry small turbomachinery, effects of vanes and splitters in diffusers and the geometry of radial blades in both compressors and turbines. Significant information on advanced projectile designs will be developed and new detailed numerical analyses will be initiated for studying projectile dynamics. Studies on rotor wake phenomena will be expanded and research results will be developed for designing stability and control systems for nap-of-the-earth flight. New techniques will be developed for determining missile plume aft-body effects in transonic and supersonic flow making it possible to accurately predict missile performance in this flight regime. Continued investigations on the muzzle flow via computational fluid dynamics will yield the first numerical solution for this complex flow environment and lay the foundation for rational design of gun muzzle brakes. Fundamental research in tribology will lead to the characterization of surfaces and the understanding of abrasive wear, cavitation and erosion. This will be coupled with investigations on rheology, infrared spectroscopy of lubricants and the use of self lubricating and composite materials. Efforts in plasticity and viscoplasticity will be maintained to further understand materials forming, crack propagation and fatigue. In the power area, the program will continue to address fundamental engine phenomena, investigate the influence of catalysts on fuel degradation or enhancement during combustion, diagnostic in-chamber combustion chemical species identification and engine

Technical/Scientific Area: #06 Title: Mechanics and Aeronautics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

test performance versus various petroleum and nonpetroleum fuels. Liquid propellant codes will be designed for required weapon performance. Personnel involved in support of this task include 4 professional and 8 support, for a total of 12.

4. (U) FY 1982 Planned Program: Increased funds will be utilized to enhance the support of those major thrust areas described in items 2 and 3. Research investigations begun and continued into FY 1981 will be supported in those fields impacting on important technological problems relating to helicopters, gun-launched projectiles, missiles, and small gas turbine aerodynamics. These projects will represent a logical and productive continuation of the FY 1981 program into FY 1982. New investigations, relating to tribology and coupled with FY 1981 initiatives, will stress surface modifications, fretting induced fatigue, contamination effects, failure diagnostics, fluid leakage mechanics and heat removal. Machine design and robotics efforts will stress kinematical behavior in hazardous environments and applications where the stamina of humans is inadequate. Investigations will be continued in the power program as to determining realistic engine design and improved performance using alternate/synthetic fuels. Fuel-air-explosives and liquid propellant research will be enhanced.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable.

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	3980	4970	6380	7690	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	*	*	*	-		

* A separate Congressional Descriptive Summary was not submitted on this scientific area in FY 1980.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #07
Project: #BH57
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Physics
Title: Research in Scientific Problems with Military Applications
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The purpose of the program is to access the nation's finest talent in physics and related research to address fundamental Army problems. The Army Research Office (ARO) physics effort complements in-house laboratory research but in such a manner as to emphasize the differences in the roles of in-house and contractual efforts. The contract program addresses issues with longer-term payoff and hopefully greater potential than is usually accommodated under the in-house effort. The ARO physics program is also concerned with issues that may be too broad for the specific mission of an individual Army laboratory. Operationally the physics program is the primary Army interface with the national physics community. ARO serves the important function of being an "interested ear" for pursuing new concepts for which the interest or expertise is not available in-house. A recent example involves the concept of phase conjugation to reconstruct laser beams that are degraded in quality by propagation through turbulence or poor optics. This concept of obvious military importance was developed under ARO contracts with results available for exploratory development in-house or by industrial effort. This area of nonlinear optics requires specialized facilities and expertise not yet available within Army laboratories. Selection of research to be performed under this scientific area is guided by the Science and Technology Objectives Guide and other planning documents as well as recognition by the staff of new opportunities through analysis of the open scientific literature. The results of this research impact a wide variety of Army problems in command and control, surveillance and target acquisition, night vision, armaments, fire control and electronic warfare.

B. (U) RELATED ACTIVITIES: This program relates to parts of the following projects in Program Element 6.11.02.A: AH42, Research in Materials and Mechanics; AH43, Research in Ballistics; AH44, Research in Fluidics, Nuclear Effects and Ordnance Electronics; AH46, Research in Combat Surveillance and Target Acquisition; AH47, Electronic Devices Research; AH48, Electromagnetic Propagation and Antenna Research; AH49, Missile and High Energy Laser Research; AH60, Research in Large Caliber Armaments; AH61, Research in Fire Control and Small Caliber Armament; AH63, Research in Electronic Warfare; A31B, Night Vision and Electrooptics Research; and B53A, Research in Atmospheric Sciences. A direct exchange of common interests is accomplished among the Services and other government agencies on a continuing basis to avoid unnecessary duplication of effort.

C. (U) WORK PERFORMED BY: This program of contracts with academic and not-for-profit institutions and industrial laboratories 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 Arizona, Tucson, AZ; Cornell University, Ithaca, NY; California Institute of Technology, Pasadena, CA; and University of Pennsylvania, Philadelphia, PA. There are in addition 44 contractors. The value of these additional contracts is $3,640,000.

Technical/Scientific Area: #07
Project: #B157
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Physics
Title: Research in Scientific Problems with Military Applications
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: An improved version of the Fast Fourier Transform called "Honest Fourier Transform" has been developed. This powerful computational technique has higher accuracy, requires much less computer storage space, and is especially suitable for discontinuous functions. A technique involving the introduction of hydrogen during the molecular beam epitaxial growth of gallium arsenide has been discovered which removes oxygen from the substrate surface. This procedure substantially increases the quality of this material for semiconductor electronic device applications. A new technique, time-resolved infrared spectral photography, has been demonstrated which allows the fingerprinting of chemical reactions and promises to be a valuable new tool for the study of chemical kinetics. The energy of formation of special types of boundaries in alloys has been calculated thereby providing detailed insight on ordering processes in binary alloys, the kinetics of which control the nucleation processes. This is the first time a first-principles theoretical calculation shows promise of providing such detailed information on the strength of materials. Significant insights have been gained into the mechanisms leading to thermal and photo-chemical decomposition of alkali azides. This knowledge will assist our understanding of lead azide, the most commonly used primary explosive whose unpredictable behavior has caused serious concern. The group theoretic analysis of possible interactions in the unit cell has been used to predict new solids with a multiplicity of properties. A new magnetoferroelectric has been established which provides the possibility of driving surface-acoustic-wave devices magnetically. It has been discovered that the quantum efficiency of lead lanthanum zirconate (PLZT) ceramics can be increased by a factor of ten to a thousand by implanting hydrogen ions into the image storage surface thereby vastly expanding the feasible applications of PLZT photoferroelectric image storage devices. A substantial difference in the attenuation of surface acoustic waves due to a magnetic field has been predicted from studies of the magnetostatic coupling between spin waves in ferromagnetic materials and Rayleigh waves. These results predict the possibility of launching acoustic waves on non-piezoelectric materials through this magnetoelastic coupling mechanism.

2. (U) FY 1980 Program: The current program includes research which will lead to the development of high energy, widely tunable infrared sources based upon both nonlinear processes in gases and crystals and coherent Raman mixing in hydrogen gas. Upconversion techniques are being studied which include two-photon resonant pumping in the nanosecond regime and use the nonlinear optical coefficients of atomic vapors for harmonic and sum generation of infrared molecular lasers. Rates of chemical reactions and vibrational energy transfer and their effect on molecular and chemical laser systems are being explored to facilitate modeling and prediction of laser performance and to develop a new level of fundamental understanding of potential surfaces and collision dynamics. The program includes a substantial effort in conventional optics and lasers. Other areas of modern optics that are being emphasized are Fourier Transform optics, propagation through random or turbulent media, speckle

Technical/Scientific Area: #07
Project: #BH57
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Physics
Title: Research in Scientific Problems with Military Applications
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

patterns, optical bistability and its relation to optical electronic processes, and optical signal processing. Near millimeter wave (NMMW) research focuses on new concepts and studies designed to elucidate fundamental mechanisms of physical systems that impact NMMW technology. The lack of good sources is the major obstacle to the development of this spectral region. Another significant thrust area is the propagation of coherent and incoherent electromagnetic radiation through the turbulent atmosphere and fog, and reflection of that radiation from surfaces of various degrees of roughness, curvature and motion. In the process, the coherent properties of the radiation change, and "speckle patterns" form. Another subarea of optics is the study of gain equations and mode patterns for high gain lasers, oscillators and amplifiers, and unstable resonators. Efforts are being made to couple ongoing theoretical work to experimental efforts in order to verify theoretical predictions. To calculate the propagation of radiation in such cavities, improved versions of the Fast Fourier Transform codes have been obtained as a byproduct of the research effort. These codes should prove to have a wide range of applicability. The solid state physics is extremely wide ranging and includes work in the fields of energetic phenomena, unique materials, unstable lattices, surface-atom interactions, forces in metals and alloys, and display technology. The energetic materials area is concerned with the discovery of new explosives with special properties and exploration of special techniques for detonation as well as the development of new diagnostic techniques. The current program includes investigations of conducting polymers which exhibit explosive properties. Research is being continued on the development of the Raman-induced Kerr effect technique which provides a new dimension to the study of a broad range of explosive and combustion phenomena. Another new diagnostic technique combines Fast Fourier Transforms and nuclear quadrupole resonance spectroscopy. This technique is presently being applied to the study of the effects of additives as well as the electronic structure of a widely used explosive, cyclotetramethylene tetranitramine (HMX) and its complexes. Research on the unique properties of materials supports investigations which seek to provide the physical basis for exploitation of classes of materials having properties which may be of interest to the Army in the long range. Included are investigations of man-made semiconductor superlattices using advanced molecular beam epitaxy techniques, intercalation compounds and stochiometric laser materials. Work is being supported in the field of atom-surface interactions to provide a realistic interaction potential that can then be used in understanding corrosion. Research performed to date has shown how such detailed knowledge of the potential can contribute to the understanding of mechanisms of pitting and wear. The results of other research indicate that surface roughness does change the atom-surface interaction potential in a measurable way. Other effort is directed to the fundamental forces that govern the mechanical properties of metals and alloys, to understand the theory of the boundary between phases, and to calculate phase diagrams from first principles. Ultimately these forces are used in predicting dynamic phenomena such as shock propagation, dissociation dynamics, and materials processing parameters. This research area includes basic research in the physics of percolation phenomena. Research is being pursued on the physics of unstable lattices dealing with those solid state systems which have low lying optic modes that are highly temperature dependent. These mode instabilities can occur either at the Brillouin zone boundary or in the middle of the zone.

Technical/Scientific Area: #07 Title: Physics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

Materials that have such lattice instabilities include pyroelectrics, piezoelectrics, and solids and liquids with very large nonlinear electrooptic coefficients. An objective is to use group theoretical arguments to predict which materials may have multiple properties (e.g., group theory predicts that certain chemical systems will be ferroelectric and/or ferromagnetic). This technique has been used to select materials for synthesis and new solid state phenomena have been demonstrated. Research is being directed toward the fundamental mechanism of electrical activity in polyvinylidene flouride (PVF_2). This is an extension of prior support which has led to the development of forms of PVF_2 which make it ideally suited for utilization in fuzes.

3. (U) FY 1981 Planned Program: The FY 1981 program will include a substantial number of continuing efforts which have been initiated with FY 1979 and FY 1980 funding. A significant new thrust will be concerned with the area of optical processing. The Army continues to have a need to develop more powerful computational techniques with high data throughput. Such techniques would find application in radar signal processing, target acquisition and terminal guidance. A solution of these problems may be obtained through research in optical processing. The number of available processing techniques should be increased and hybrid optical/digital processors developed through the efforts of investigators in conventional and nonlinear optics with contributions from the field of electronics and engineering. The input and output transducers continue to limit the real time operation of the optical processor. Research in materials and electronics combined with basic light scattering measurements are required to improve the available transducers. A second area of major thrust will be that of the limits of size in electronic devices. As the dimensions of electronic devices are reduced below 0.1 micrometer conventional electron transport no longer applies. Research will be pursued to obtain a fundamental understanding to the physics of electron transport in ultra-small electronic devices. This research program will be coordinated with other Army Research Office and in-house laboratory programs which will address materials and electronics issues as well as the mathematical implications of such devices. Personnel involved in the support of this task include 5 professional and 11 support, for a total of 16.

4. (U) FY 1982 Planned Program: The FY 1982 program will be based on a continuation of the work described in the foregoing sections. The flexibility to initiate new thrusts as promising areas of physics and corresponding Army needs become evident will be maintained.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable

Technical/Scientific Area: #07
Project: #BH57
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Physics
Title: Research in Scientific Problems with Military Applications
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	4587	5825	7430	9240	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	4688	5799	7618	-	Continuing	Not Applicable

The funding differences between the FY 1980 submission and current requirements reflect minor changes in emphasis.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #08 Title: Chemistry
Project: #B157 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The chemistry program has the mission of contributing to the technology base through fundamental investigations of diverse phenomena on a molecular level. Such investigations play an essential role in helping to meet both present and future requirements of the Army in such areas as electrochemical energy conversion, chemical decontamination, pollution abatement, personnel protection, development of improved energetic materials, camouflage, degradation of materials, detection, and the synthesis of novel materials with properties tailored to Army requirements. Determination of these requirements and a constant awareness of problems confronting the Army both in the short and long term is attained through an analysis of the Army's Science and Technology Objectives Guide FY 1980 and through the maintenance of a working knowledge of both the fundamental and applied research plans of the appropriate Army laboratories. Strategy is determined from these analyses, through close working relationships with the staffs of these Army laboratories, through the organization of intense topical workshops, and through a variety of interfaces with the scientific community as a whole. Close coupling of scientific advances with other segments of the government and with the private sector is maintained to insure technology transfer.

B. (U) RELATED ACTIVITIES: The chemistry program is closely coordinated with and is responsive to the research objectives of the pertinent Army laboratory. This is demonstrated through the close relationship of the program to ten other 6.11.02.A projects. Close coordination and information exchange is maintained with other DOD agencies as well as with the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Science Foundation, the Department of Energy, and the Petroleum Research Fund.

C. (U) WORK PERFORMED BY: This program is managed by the US Army Research Office, Research Triangle Park, NC. The top five contractors are: Stanford Research Institute, Menlo Park, CA; California Institute of Technology, Pasadena, CA; University of Southern California, Los Angeles, CA; University of Texas, Austin, TX; and Duke University, Durham, NC. The total number of additional contractors is 61. The total dollar value of these additional contracts will be $3,040,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Notable progress was made in the areas of synthesis and chemiluminescence, and in laser technology. The synthesis of new thermoplastic propellant binders offers the potential for easier handling and for the recycling of the propellant which should result in significant cost savings. The discovery of catalytically enhanced chemiluminescence promises the addition of a highly efficient new system for the production of cold light for

Technical/Scientific Area: #08 Title: Chemistry
Project: #B157 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

utilization as markers and remote site identification, and as light sources. Fundamental work on the excited states of atoms, diatomic molecules, and diatomic ions led to the discovery of the excimer laser which has opened new vistas for exploration in the ultraviolet region of the spectrum and has led to the development of applications not only on satellites but also tactical uses including target designation, projectile guidance, and the conversion of digitized mapping data to hard copy.

2. (U) FY 1980 Program: The investment strategy for the chemistry program is directed toward increasing the opportunities for accelerating solutions to critical Army problems. This is being accomplished through the funding of exceptionally relevant projects at significantly higher levels. This enables especially talented investigators to work more effectively and efficiently toward bringing a faster payoff in designated areas including ignition and combustion of propellants, gun-tube wear and erosion, and smokes and aerosols. Increases in the level of funding are also being invested in larger equipment purchases necessary for state-of-the-art diagnostics required in highly relevant areas including surface chemistry, catalysis, combustion research, and sensing and detection. Addition of projects responsive to the Chemical-Biological and Chemical Warfare requirements of the Army is planned for this fiscal year. The necessary groundwork has been laid through the support of relevant meetings, personal contacts, and through organizing and conducting relevant workshops in the areas of decontamination, detection, and fibers. There is continued emphasis on the synthetic aspects of the chemistry program. These are being directed toward the development of new materials with tailored properties including stronger and tougher elastomers and high modulus fibers. Such materials have uses in tank track pads, tank suspension systems, personnel body armor, helicopter components, and in numerous other high stress environments. Continued investment in the development of more effective energetic materials and with higher efficiencies in their production is planned. Programs in upper atmospheric chemistry and in photochemistry are being sharply deemphasized due to the decline in interest and requirements for these areas.

3. (U) FY 1981 Planned Program: The majority of the chemistry program described above will be continued due to the long range nature of the program. Flexibility will be maintained in order that fresh ideas can be brought into the program without undue delay and so that programmatic changes can be responsively made to the ever changing requirements of the modern Army. It is planned that increased emphasis will be given to the area of material degradation. This includes the development of fundamental approaches for the prediction of service lifes for Army materiel. Pay-off will be not only in design and materials savings but also in [redacted]ded lifetimes and confident prediction of useful service periods. A workshop is to be held in FY 1980 to emphasize t[redacted]ests in the future expansion of investment in this field. Personnel involved in support of this task include 4 profes[redacted] and 8 support, for a total of 12.

Technical/Scientific Area: #08
Project: #88157
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Chemistry
Title: Research in Scientific Problems with Military Applications
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

4. (U) FY 1982 Planned Program: Close monitorship of the ongoing chemical research and development programs and emerging problem areas within the Army will be maintained and analyzed in order to determine appropriate emphasis for the chemistry program. Concurrently, an alertness for new research opportunities emerging from developments in the chemical sciences will be maintained in order to assure maximum responsiveness of the chemistry program to Army requirements. Further, it is planned to give continuing emphasis to the fundamental and long-range nature of the chemistry program to assure productivity and responsiveness to the requirements of the Army in future years.

5. (U) *Program to Completion: This is a continuing program.*

6. (U) Major Milestones: Not Applicable

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	3892	4810	6040	7480	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	*	*	*	-		

*A separate Congressional Descriptive Summary was not submitted on this scientific area in FY 1980.

FY 1981 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: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) 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 development of 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. (U) 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 the Office of the Secretary 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 program element 6.11.02.A, project AH43, Research in Ballistics; 6.11.02.A, project AH61, Research in Fire Control and 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 in program element 6.11.02.A.

C. (U) 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. The top five contractors that will receive money under this project are: Princeton University, Princeton, NJ; New York State University, Albany, NY; GO Centers Inc., Newton Falls, MA; Iowa University, Ames IA; and General Electric Corporation, Detroit, MI. An additional 11 contractors will receive funds totaling approximately $212,000 under this project.

Project: #AH60 Title: Research in Large Caliber Armaments
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: A new propellant surviellance test has been developed which has potential of major improvement in assuring safe storage of propellants in the field. Preliminary correlation between high rate compression breakup and the low temperature burning rate has been established for conventional and new propellants. A new method for developing polyvinylnitrate, a potential nitrocellulose replacement, has been developed. A nitrocellular-nitramine complex was prepared. This material offers a new approach to producing high energy propellants which do not contain a solid filler component which adversely affects both combustion and mechanical propellant properties. A defraction procedure for physical characterization of cellulose was developed which may offer improved quality control of cellulose for nitrocellulose manufacture. A new rapid method of propellant chemical analysis was formulated which has improved accuracy. A metastable phase of cadmium sulfide was achieved by pressure quenching at rates exceeding one million bars per second from above fifty kilobars. The new phase exhibits unique magnetic properties at room temperature consisting of diamagnetism and high level paramagnetism. There is a diamagnetic transition that is characteristic of superconductivity. A palladium-silver alloy was successfully implanted with hydrogen at six million electron volts. The hydrogen concentrations were profiled. The strength of electrodeposited chrome as a function of current density at a deposition temperature of eighty-five degrees centigrade has been established. Adherent tantalum coatings ranging in thickness from one half to twelve millimeters have been obtained using ion deposition. This new low contractional chrome alloy did not crack in the substrate under high contact stress in the gear-roller wear test.

2. (U) FY 1980 Program: Resume synthesis of explosive with possible high output and good stability. Develop synthesis process for using promising compounds as propellants. Examine triaminotrinitrobenzene structure by neutron defraction. Determine the effects of the composition on the mechanical properties of propellants. Continue the development of holographic technology for ignition diagnostics. Begin the study of liquid propellant spray ignition and define its characteristics. Explore the possibility of explosive desensitization by diphenilamine. Investigate the effect of intramolecular amino groups on trinitrotoluene sensitivity. Prepare and investigate samples of new high density high energy detonating systems. Investigate the role of defusion of various materials in the erosion process. Determine emissivities of various pyrophoric compounds and means of enhancing them. Seek additives to control surface temperature and time duration of pyrophoric reactions. Search for more effective muzzle flash suppressing additives and improved methods of incorporating them into propellant charges. Begin determination of far infrared muzzle flash signatures. Super conductivity transition temperature of cadmium sulfide is being established, and investigation into potential metastability in other compounds is being initiated. Techniques to enhance the adhesion and density properties of refractory coatings will be examined. Penetration perfomance as a

Project: #AH60 Title: Research in Large Caliber Armaments
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

function of density and size of spherical penetrators will be extended to higher velocity. The decoppering performance and mechanisms in the presence of binary alloys is being pursued and the role of iron and copper on coppering mechanisms is being investigated.

3. (U) FY 1981 Planned Program: Study the preparation of nitrated metacyclophane explosives. Study the controlled degradation of nitrocellulose to obtain the desired viscosity. Extend the new method of propellant analysis to single and triple base propellants. Determine flame speed and burning rate of liquid propellant spray. Continue studies of the fundamental processes involved in the frictional ignition of explosives. Continue activator studies of premature ignition via base gaps. Test effect of additives on propellant flame structure. Complete studies of pyrophorics for decoy applications. Initiate studies into the stabilization/release mechanisms of hydrogen in lead-silver alloys. Continue investigation of the superconductivity and magnetic properties of pressure induced metastable phases in excitonic solids. Ion and organo-metallic deposition techniques will be pursued for refractory erosion resistant coatings. Definition of orifice parameters as a function of fluid characteristics will continue and efforts initiated to define new types of compressible recoil fluids. Definitions of coppering mechanisms will be completed and decoppering studies extended to other alloys and materials. Initiate studies into the stress distribution in composite penetrators. This project will support 95 in-house personnel (74 professional and 21 support personnel).

4. (U) FY 1982 Planned Program: Pressure synthesis of hydrides and excitonic conducting materials as potential high temperature superconductors will be emphasized. Preparation of polynitroferrocenes as possible ignitors, initiators and explosives will be persued. Formulate amine nitromides into propellant compositions and determine their ballistic characteristics. Investigate the mechanism of irreversible growth in tri itrotoluene under thermal cycling. Investigate effects of additives on the mechanical properties of explosives and propellan s. Determine the source of gases in so-called gasless metal-oxidant mixtures used in rocket-assisted projectile systems. Determine the factors affecting the rate of energy release in nonideal explosives. Determine relative importance of particle size, density, and chemical discontinuities on stability of detonation waves in solids. Exploit new concepts to improve the properties of chrome and techniques for deposition of refractory cooled coatings. Materials studies of the amorphous state of heavy metal composites and laminates construction will continue. Ion and organo-metallic deposition of refractory coatings will be optimized for coating properties. Homogeneous refractory alloy development will be initiated, and wear and erosion mechanisms studied. Amorphous coatings and homogeneous materials will be evaluated for potential erosion resistivity. Exploit technical base efforts in areas of high pressure synthesis of lead-silver-hydrogen materials as potential high temperature superconductors and composite technology for enhancing kinetic energy penetration performance.

Project: #AH60 Title: Research in Large Caliber Armaments
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	5100	5515	6500	7620	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	5160	5970	6500	-	Continuing	Not Applicable

During FY 1979 $60 was transferred to project BH57. The $455 reduction in FY 1980 between planned and current requirements was necessitated by the Congressional reduction in program element 6.11.02.A ($400) and the Congressional directive to reduce service support contracts ($55).

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #BS10 — Title: Research on Military Diseases, Injury and Health Hazards
Program Element: #6.11.02.A — Title: Defense Research Sciences
DoD Mission Area: #510 - Defense Research — Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This is a restructured Project. The soldier is the single most important component in land combat. Each individual must be in a high state of medical preparedness for combat operations, i.e., physiologically and mentally fit and protected to the greatest degree possible from the many health hazards which may impair his or her ability to perform. To assure these conditions are maintained, research is conducted to identify and assess potential military health hazards, define human tolerances to those hazards, and develop the technology which will extend the tolerance limitations, protect the individual when those limitations are exceeded, and, when all else fails, provide the mechanism to successfully treat the individual, thus preserving life and conserving the most valuable ingredient of our combat resources. Emphasis is on new and classical methods in biochemistry, epidemiology, immunology, microbiology, pathology, pharmacology, physiology, toxicology, neuropsychiatry, and related biomedical disciplines. These technologies are focused on fundamental knowledge gaps in detection, assessment, prevention and treatment of disease, injury and other health hazards which impact on military operations, mobilization and/or training worldwide. They are essential elements of the medical RDT&E program because they provide the science base from which all new products, techniques and methodologies are derived. Scientific areas of concern are those of military importance which receive inadequate attention from other medical research agencies.

B. (U) RELATED ACTIVITIES: This Project is a consolidation of Projects BS01, Basic Research on Military Injury and Diseases; BS02, Basic Mechanisms of Recovery from Injury; BS03, Medical Defense Against Biological Agents; BS05, Military Burn Research; BS06, Combat Dental Materials and Techniques; BS07, Helicopter, Combat Crew and Airborne Medicine; BS08, Environmental Stress, Physical Fitness and Medical Factors in Military Performance; and the biomedical portion of A71A, Research in Defensive Systems for Chemical Warfare/Biological Warfare. These projects and task have been combined to provide greater flexibility to respond more rapidly to new mission requirements. Research is performed in support of Army program elements 6.27.70.A, Military Disease Hazards Technology; 6.27.72.A, Combat Casualty Care Technology; 6.27.77.A, Systems Health Hazards Prevention Technology; 6.27.34.A, Medical Defense Against Chemical Agents; 6.27.75.A, Combat Maxillofacial Injury; 6.37.50.A, Drug and Vaccine Development; 6.37.32.A, Combat Medical Materiel; and, 6.47.17.A, Project D832, Combat Medical Materiel. Complementary research is conducted by other Army organizations under this program element and by the US Navy and Air Force. Complementary research also is conducted by the Department of Health, Education and Welfare and Department of Agriculture. Army representation on Department of Defense coordinating committees and other intergovernmental coordination councils insures information exchange at the working and administrative levels to avoid duplication of effort.

Project: #BS10 Title: Research on Military Diseases, Injury and Health Hazards
Program Element: #6.11.02.A Title: Defense Research Sciences
DoD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

C. (U) WORK PERFORMED BY: Work is conducted by in-house laboratories of the US Army Medical Research and Development Command at the Walter Reed Army Institute of Research, Washington, DC; US Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD; US Army Research Institute of Environmental Medicine, Natick, MA; US Army Aeromedical Research Laboratory, Fort Rucker, AL; US Army Institute of Surgical Research, Fort Sam Houston, TX; Letterman Army Institute of Research, Presidio of San Francisco, CA; US Army Institute of Dental Research, Washington, DC; US Army Biomedical Laboratory, Aberdeen Proving Ground, MD; US Army Bioengineering Research and Development Laboratory, Fort Detrick, MD; and overseas special foreign activities of the Walter Reed Army Institute of Research located in Thailand, Malaysia, Germany, and Brazil. Approximately 22% of the research is conducted under contracts with universities, non-profit organizations and industry. The five top contractors are Mount Sinai School of Medicine, New York, NY; Medical College of Virginia, Richmond, VA; Oak Ridge National Laboratory, Oak Ridge, TN; University of New Mexico, Albuquerque, NM; and JAYCOR, Inc., Del Mar, CA. There are 61 other contractors funded in the amount of approximately $4,000,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: In the area of infectious disease research, formulated new concepts for predicting microbial behavior in infection, host immune response to infection, and vaccine improvements through use of purified subunits; developed new methods of disease diagnosis and vector identification; developed new animal models for studying disease and testing drug efficacy. Key accomplishments were the demonstration that rickettsiae from two different species of colonized mites produced disease of different virulence in laboratory animals; described the pathogenesis of Legionnaires' disease in animals; determined that sensitized white blood cells destroy bacteria only in the presence of specific antisera; found that two strains of dengue 2 virus contain different proteins; developed a radioimmune assay procedure for viral antigen and antibodies; and developed a nonhuman primate model for African trypanosomiasis. Work was performed under Projects BS01 and BS03 (see BS10-01 summary). In the area of combat casualty care research, elucidated mechanisms of host defense alterations following injury and during septicemia; evaluated new concepts of burn prevention and treatment, developed data base to support studies of improved blood products and blood substitutes, assessed pathophysiology of injury and explored research opportunities in improved combat casualty care of burn injury. Work was performed under Projects BS01, BS02, BS05, and A71A (see BS10-02 summary). In the area of systems and environmental health hazard assessment research, developed technology for determining cellular effects of low energy laser and microwave radiation; identified criteria for measuring cold injury potential; demonstrated ability to modify animal response to heat; developed methodology for measuring human physical ability, established data base for the physiological effects and human tolerances to impulse noise, and began establishing a data base for toxicologic assessment of military unique compounds such as new smokes and obscurants. Work was performed under Projects BS01, BS07, and BS08 (see BS10-03 summary). In

Project: #BS10 Title: Research on Military Diseases, Injury and Health Hazards
Program Element: #6.11.02.A Title: Defense Research Sciences
DoD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

area of dental injury and disease research, demonstrated feasibility of using biodegradable polymers and copolymers for repair of esophogeal discontinuities; discovered a biological factor which may make it possible to control bone resorbtion after traumatic injury; identified differences in protein content of saliva which may be the basis for early diagnosis of exposure to chemical agents; developed animal models for dental disease and basic data on substitution of ceramics for bone in maxillofacial repair. Work performed under Project BS06.

2. (U) FY 1980 Program: Maintain science base for support of infectious disease risk assessment and prevention technology. Continue epidemiologic surveillance of diseases of military importance while improving survey methodology and discovering new ways of intervening in the cycle of disease transmission. Expand knowledge of disease processes by studying microbial alterations, host reactions, and host-agent interactions during the course of infection. This knowledge will provide the basis for rapid diagnosis, early immunologic or chemotherapeutic intervention and development of safe, effective vaccines that protect against exposure. Expand the pharmacologic data base of the established drug development effort to broaden its applicability to specific parasitic, viral and bacteriologic diseases of military importance and to increase its potential to support antiradiation and antichemical drug development efforts. Level of effort in FY 80 is equivalent to that in FY 79 at the same laboratories and the same or similar contractors. Maintain ongoing research in combat casualty care while continuing to assemble the technologies required to support new research concepts as they are developed and incorporated into the program. Continue research in shock physiology and on blood/fluids for resuscitation. Expand fundamental research in casualty diagnosis, mechanisms of wound healing and use of pharmaceuticals in treatment of combat injuries. Establish science base to define mechanisms of action of chemical agents in order to develop a rational approach to chemoprotectives, antidotes and chemotherapeutics. Develop standardized animal and cellular models for the elucidation of the mechanisms of poisoning by chemical agents and development of rationale for treatment. Increase level of effort with new starts in basic research for medical defense against chemical agents. Most of this increase is at the US Army Biomedical Laboratory and in new contracts, although three other Army laboratories are involved. Level of effort for other portions of combat casualty care research remain equivalent to FY 79 at the same laboratories and with the same or similar contracts. Maintain existing capability to conduct research on human physiologic and psychologic tolerances to operational workloads, environmental extremes, noise, vibration, nonionizing radiation, and smokes, fumes and other military toxicants. Increase efforts where new knowledge is critical to development and fielding of new weapons systems without losing ability to investigate a broad array of potential training and battlefield health hazards. Impulse noise, low frequency noise, vibration, low energy lasers, potentially toxic gases and smokes and translocation are physiologic and psychologic insults of urgent military importance. Levels of effort remain equivalent to FY 79 at the same laboratories and with the same or similar contracts. Maintain science base capacity to support maxillofacial and dental disease prevention and treatment research at a slightly reduced level of effort compared to FY 79.

Project: #BS10 Title: Research on Military Diseases, Injury and Health Hazards
Program Element: #6.11.02.A Title: Defense Research Sciences
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3. (U) FY 1981 Planned Program: Maintain the infectious disease science base to assure that efficient and timely data and technology is available to support development of the medical means to protect soldiers against disease hazards. Efforts will concentrate on expansion of the data base for incidence and prevalence of specific diseases and identification of factors which may be used to reduce their military threat; development of new diagnostic methodology having increased sensitivity and specificity; characterization of genetic and molecular properties of infectious agents that are responsible for disease and that elicit immune responses in the host (particularly those characteristics that may be exploited to develop new drugs or more effective vaccines); broadening of the data base for pharmacologic properties of drugs and their potential for use to prevent infection or treat disease; and discovery of new models of diseases from which data applicable to man may be extrapolated. Personnel to be utilized: 165 professional and 200 support. Expand that portion of the combat casualty care science base dedicated to protecting the soldier from the effects of chemical agents while maintaining the science base dedicated to treatment of other combat injuries. Efforts will concentrate on rapid expansion of the data base required for discovery and evaluation of chemical antidotes, prophylactic drugs and patient decontamination systems; and on continued development of an integrated science base that will productively investigate new areas of research and continue pertinent research in resuscitative fluids, shock, trauma, wound healing and burn and ionizing radiation injury. Personnel to be utilized: 83 professional and 104 support. Expand and complete integration of the science base for support of health hazard assessment research to permit flexible multidisciplinary applications to critical questions about the soldiers' physiologic and psychologic tolerances in the training/battlefield environment. Efforts will concentrate on descriptions of mechanisms of heat and cold injury and new approaches to prevention and treatment; determination of causes of hearing loss and effects of vibration on body systems; investigation of the neurophysiology of sight and visual perception; development and validation of short-term toxicology tests; examination of effects of stress, fatigue, drug abuse, and toxic hazards on vigilance/attention and the neurophysiologic and neuroanatomic relationships; and establishment of a data base on bioeffects of specific microwave and new generation laser radiation hazards. Personnel to be utilized: 94 professional and 117 support. Maintain the science base in support of dental disease and maxillofacial injury technology to improve the soldiers' dental health and provide better treatment of dental injuries. Efforts will concentrate on characterization of dental disease and maxillofacial injuries in combat; basic investigations of host tissue reactions to dental materiel; and the prevalence, cause and effect of microleakage at the dental materiel-tooth interface. Personnel to be utilized: 6 professional and 10 support. Total personnel to be utilized: 348 professional and 431 support.

4. (U) FY 1982 Planned Program: Continue to expand science base dedicated to studying mechanisms of biological systems failure caused by chemical agents and formulating and testing concepts for intervention. All other efforts will be maintained at or near level of effort. Continue basic research to support development of infectious disease risk assessment, prevention and control technology. Improve methods of ecologic survey and vector control. Expand knowledge of mechanisms for enhancement

Project: #BS10 Title: Research on Military Diseases, Injury and Health Hazards
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of the host immune response and test theories for improving vaccine development technology. Determine basic mechanisms for antiviral and other antimicrobial activity of effective drugs. Provide required basic information to drive development of improved techniques for patient resuscitation, stabilization, healing and treatment. Continue efforts to standardize animal models for quantifying biological effects of chemical agents, prophylactics and antidotes. Continue development of biomedical data base for systems performance in chemical casualty decontamination. Continue development of modeling techniques to determine human indices of tolerance and exposure to physical and sensory hazards. Continue to develop rapid toxicology tests. Initiate stress neurochemistry studies of extended sleep loss, continuous performance demands, low level toxic substance exposure and certain neurologic disorders. Continue basic microwave and laser radiation investigations. Continue dental disease and maxillofacial analysis and explore basic mechanisms for prevention and treatment.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable.

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	19037	21102	25320	28900	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	19081*	22185*	24346*	-	Continuing	Not Applicable

*Funds shown here were previously shown under Projects BS01, BS02, BS03, BS05, BS06, BS07, BS08 and a portion of A71A. The decrease of $44 in FY 1979 resulted from funding adjustments made near the end of the fiscal year to make maximum utilization of available funds. The $1083 reduction in FY 1980 was due to the Congressional appropriation reduction in Program Element 6.11.02.A ($1000), the Congressional directive to reduce travel ($35), and the Congressional directive to reduce service support contracts ($48). The increase in FY 1981 over last year's estimate will permit increased emphasis on that portion of the combat casualty care science base dedicated to protecting the soldier from the effects of chemical agents, will provide for limited expansion of basic technology supporting drug and vaccine development, and will provide integration of the science base for health hazard assessment research.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #01
Project: #BS10
Program Element: #6.11.02.A
DoD Mission Area: #510 - Defense Research

Title: Military Disease Hazards Research
Title: Research on Military Diseases, Injury and Health Hazards
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This scientific area was created when Project BS10 was structured. The soldier is the most important component of the land combat system and must be maintained in a high state of medical preparedness for combat operations. In an effort to prevent disease casualties from becoming lost to the combat commander, the science base is maintained to establish methodology used for medical assessment of health hazards or development of prevention or treatment modalities. To this end, research is conducted utilizing new and classical techniques of immunochemistry, histopathology, serology, immunology, microbiology, and epidemiology on infectious diseases with existing or potential effect on military operations. Studies are directed toward better understanding of basic pathogenesis of militarily unique infections. Worldwide information on the distribution, ecology, taxonomy, and control of arthropod vectors of disease is developed to provide the epidemiological data base necessary for further progress in the protection of the health of Army personnel.

B. (U) RELATED ACTIVITIES: Research was previously conducted under Project BS01, Basic Research on Military Injury and Diseases; and Project BS03, Medical Defense Against Biological Agents. Related work is performed under Program Elements/Projects 6.27.70.A/A870, Risk Assessment of Military Disease Hazards, and A871, Prevention of Military Disease Hazards; and 6.37.50.A/A808, Drug and Vaccine Development. Complementary infectious disease research conducted by the US Navy, National Institutes of Health, Department of Agriculture, and the Center for Disease Control is pertinent to this project. Army representation on Department of Defense coordinating committee and other inter-governmental agency coordination councils insures coordination at the working and administrative levels to prevent duplication of effort. Army scientists serve as consultants to the World Health Organization and have access to this organization's studies, reports, and publications. Other coordination is accomplished by personal contacts at the operating level, site visits by project officers, organization of technical 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 resumes.

C. (U) WORK PERFORMED BY: About 80% of the work is conducted by in-house laboratories at Walter Reed Army Institute of Research, Washington, DC, and affiliated field unit in Africa; the US Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD; the US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD; and Letterman Army Institute of Research, Presidio of San Francisco, CA. Approximately 20% of the research is conducted under contracts with universities, non-profit organizations, and industry. The top five contractors are Mount Sinai School of Medicine, New York, NY; Columbia University, New York, NY; University of California, Berkeley, CA; University of California, Davis, CA; and Colorado State University, Fort Collins, CO. Seventeen other contractors are also funded in the amount of $951,000.

Technical/Scientific Area: #01
Project: #BS10
Program Element: #6.11.02.A
DoD Mission Area: #510 - Defense Research

Title: Military Disease Hazards Research
Title: Research on Military Diseases, Injury and Health Hazards
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Developed new techniques to improve disease diagnosis: a radioimmune assay procedure for quantitation of viral antigen and antibodies; a specific and sensitive microtiter neutralization test for adenovirus antibody using transformed human embryonic kidney cells; a plaque reduction test useful for strain characterization and comparison of rickettsial organisms. Developed new concepts and principles for assessment of disease (epidemiology): demonstrated that strains of Rickettsia tsutsugamushi (scrub typhus) in colonies of two different species of vector mites differed widely in virulence for laboratory animals; developed a nonhuman primate model for African sleeping sickness; further defined etiology of Korean hemorrhagic fever; developed a nonhuman primate model for scrub typhus; and elucidated the host/vector relationships of infectious diseases of military importance. Expanded basic knowledge of host/microbial interactions for increased understanding of disease processes and identified areas for disease intervention: determined that sensitized white blood cells destroy bacteria only in the presence of specific antibody; improved techniques for culture of animal intestine to provide a better understanding of the pathogenesis of diarrheal disease; continued the investigation of disseminated intravascular coagulation in the pathogenesis of trypanosomiasis; described cellular changes during infection with bacterial and viral organisms; described the pathogenesis of Legionnaires' disease bacteria in animal models; described the mechanism of action of bacterial toxins; described biochemical and physiological changes in the host following infection with selected microorganisms; described the response of an animal host to experimental infection with the agent of cutaneous leishmaniasis; established new techniques to evaluate host-cell mediated and humoral immune responses to immunoprophylactic agents in man and experimental animals. Increased knowledge of specific organisms/toxins which will lead to new or improved vaccines: improved in vitro culture techniques for Plasmodium (malaria) for vaccine development; demonstrated that the antigenic character of a population of Trypanosoma (African sleeping sickness) was composed of perhaps only one serodeme which was antigenically stable over an eight-year period; isolated a high molecular weight polysaccharide from Pseudomonas bacteria that protects mice from experimental infections; isolated and purified subcellular components of rickettsial organisms; further defined the antigenic cross-reactivity between dengue and yellow fever viruses; found that two strains of dengue 2 virus contain distinctly different proteins when examined by two different physical/chemical techniques; improved the techniques for purifying bacterial toxins; determined the sequence of amino-acids of enterotoxins. Increased knowledge of basic mechanisms of action of drugs and repellents that will result in new or improved products: described cellular and biochemical changes induced in the host by newly developed drugs; correlated chemical and physical properties of repellents and formulation additives with mechanisms of action on arthropod vectors; determined the response of skin to chemical insect repellents; described the pathogenesis of fungal skin infections.

Technical/Scientific Area: #01
Project: #BS10
Program Element: #6.11.02.A
DoD Mission Area: #510 - Defense Research

Title: Military Disease Hazards Research
Title: Research on Military Diseases, Injury and Health Hazards
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

2. (U) FY 1980 Program: Continue studies in rapid diagnostic capabilities for enhanced intervention in disease processes and field identification of militarily relevant infectious agents. Maintain science base for support of development of infectious disease risk assessment technology; and develop concepts and methods for collection and interpretation of vector-disease data. Identify new microbial-host interactions that influence disease and immunity: define microbial genetic and molecular properties responsible for virulence and antigenicity; expand knowledge of cellular and subcellular alterations during infection to provide basis for diagnosis/prevention/intervention; study host energy metabolism during infection; develop better animal models for parasitic disease (viz: neurological trypanosomiasis). Continue basic investigations for improvement of existing vaccines/toxoids and development of potential new products: develop data on structure/composition of microorganisms and toxins; search for new methods of purifying and using microbial products and adjuvants to improve vaccine technology development. Maintain existing science base for support of antimicrobial drug development program to include developing and testing newer drug delivery systems (liposomes) that are more stable and efficient. Investigate basic technologies for control of arthropod vectors of disease; develop pest management systems (biological control and repellent development) effective in reducing diseases of military importance.

3. (U) FY 1981 Planned Program: Develop new diagnostic procedures with increased specificity and sensitivity that will lead to rapid diagnosis of diseases of military importance. Continue basic research on epidemiological parameters associated with infectious disease. Continue to evaluate host responses that can serve as diagnostic criteria and a base for developing new concepts for prevention and treatment of infectious disease; expand characterization of structural and genetic factors which influence virulence and the host immune response to microbial organisms; expand development of animal models for parasitic diseases. Expand knowledge of immunologic mechanisms which can be employed in the development of new vaccines, toxoids and antitoxins; continue the search for new adjuvants and microbial products to enhance the immune response. Maintain existing science base for support of antimicrobial drug development program; and continue investigation of more effective drug carriers. Establish science base for determination of chemical, physical and toxicological properties of repellents; continue laboratory evaluation of biological control agents for insect vectors. Personnel to be utilized: 165 professional and 200 support.

4. (U) FY 1982 Planned Program: Expedite development of diagnostic procedures with increased specificity and sensitivity that will lead to rapid diagnosis of militarily relevant diseases. Develop new concepts and techniques that will expand the data base relating to the ecology and epidemiology of militarily relevant infectious diseases. Continue basic investigations on factors influencing occurrence, distribution and severity of infectious disease with military implications. Refine information of cellular and subcellular alterations during infection to provide basis for more rapid and definitive diagnosis/prevention/

Technical/Scientific Area: #01
Project: #BS10
Program Element: #6.11.02.A
DoD Mission Area: #510 - Defense Research

Title: Military Disease Hazards Research
Title: Research on Military Diseases, Injury and Health Hazards
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

intervention. Continue basic investigations on pathogenesis and host response to infectious diseases of military importance to enable development of methods for controlling these diseases in military populations. Continue basic research relating to structure and composition of microorganisms and toxins and apply new technology to expand knowledge of immunologic mechanisms to enable development of immunoprophylactic measures for controlling infectious diseases. Continue to search for more effective means of enhancing host immunity to infectious agents. Maintain existing science base for support of antimicrobial drug development program and continue investigation of drug carriers. Broaden science base for biological control of insect vectors in vivo and in vitro.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable.

7. (U) Resources ($ in thousands):

RDTE	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
Funds (current requirements)	10177	10797	12583	14361	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	10192	10845*	12208	-	Continuing	Not Applicable

The $15 reduction in FY 1979 was the result of minor funding adjustments near the end of the fiscal year to make maximum utilization of available funds.

*Funds shown on FY 1980 submission for FY 1980 were under Projects BS01 ($7672) and BS03 ($3173). The $48 reduction in FY 1980 was due to the Congressional directive to reduce travel ($18) and the Congressional directive to reduce service support contracts ($30). FY 1981 estimates for these efforts as shown on the FY 1980 submission were under Projects BS01 ($8918) and BS03 ($3290). The increase in FY 1981 funds will enhance the science base for critical vaccine and drug development programs.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #02
Project: #BS10
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Combat Casualty Care Research
Title: Research on Military Diseases, Injury and Health Hazards
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This scientific area was created when Project BS10 was structured. It provides the medical research and development required to minimize deaths and disabilities, and to improve survivability, patient care, and mission accomplishment in a combat environment where hostile forces employ a multitude of weapons. It is designed specifically to provide the science base required to drive technological breakthroughs in treating casualties resulting from the use of conventional and nonconventional weapons and in minimizing the vulnerability of troops to chemical warfare (CW) agents, and to ionizing radiation from nuclear weapons. Present emphasis is placed on developing the data base to define the pathophysiology of injury; identifying mode of action and interaction of anesthesia drugs; defining the pharmacokinetics, pharmacology and toxicology of anti-shock, antiradiation, and antichemical drugs; defining the mechanism of action and the pharmacological and toxicological sequence of effects of CW agents; and identifying biologic markers for the sites of action and kinetics of CW and other toxic agents.

B. (U) RELATED ACTIVITIES: Work was previously performed under Projects BS01, Basic Research on Military Injury and Diseases; BS02, Basic Mechanisms of Recovery from Injury; BS05, Military Burn Research; and A71A, Research in Defensive Systems for CW/BW. Related work is performed under Program Element 6.27.72.A, Combat Casualty Treatment Technology, and also under Program Element 6.27.34.A, Medical Defense Against Chemical Agents. Complementary research conducted by the Navy and the National Institutes of Health is pertinent to this project. Army representation on Department of Defense coordinating committee and other intergovernmental agency coordination councils insures coordination at the working and administrative levels to prevent duplication of effort. Other coordination is accomplished by personal contacts at the operating level, site visits by project officers, organization of technical 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 resumes.

C. (U) WORK PERFORMED BY: In-house research is performed by the Letterman Army Institute of Research, Presidio of San Francisco, CA; Walter Reed Army Institute of Research, Washington, DC; the US Army Institute of Surgical Research, Fort Sam Houston, TX; and the US Army Biomedical Laboratory, Aberdeen Proving Ground, MD. Contracts are with the Regents of the University of California, La Jolla, CA; Peter Bent Brigham Hospital, Boston, MA; Albert Einstein College of Medicine, Bronx, NY; and the University of Cincinnati, Cincinnati, OH.

Technical/Scientific Area: #02
Project: #BS10
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Combat Casualty Care Research
Title: Research on Military Diseases, Injury and Health Hazards
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: A factor causing depressed immune response was identified and characterized from sera of burn patients. Studies have been completed to determine the effects of septicemia on the host-immunologic defense system. Methodologies for the topical prevention of burn wound infection were investigated. Developed data base to support studies on extending shelf-life of whole blood and formulating effective cell-free fluids for resuscitation. Basic research opportunities to improve treatment of combat casualties were explored. Assessed pathophysiology of injury.

2. (U) FY 1980 Program: Direct studies in wound healing toward determining the biochemical, structural and physiologic factors involved in healing. Research in the alteration of host resistance is used to define the basis of susceptibility to infection. Continue to study the ability of white blood cells to destroy bacteria. Conduct research on the gastrointestinal alterations and complications in injured troops. Work is ongoing to document the site of inhalation injury and the alterations in pulmonary function and pulmonary complications in injured and burned soldiers. Initiate basic pharmacology studies to support anti-shock drug development. Focus is on biochemical basis for oxygen carrying capacity of resuscitating fluids. Continue programs to evaluate the influence of fluid resuscitation on the hemodynamic response to mechanical and thermal injury. Initiate studies in chemical defense to define the mechanisms of actions and the pharmacological and toxicological sequence of effects of chemical agents to include identification of biologic markers for the sites of action and kinetics of chemical warfare (CW) poisoning. This information is used to develop the logic for defining ways of interfering or blocking CW agent-induced injuries. Special consideration is given to defining the effects of CW agents on neurologic, ophthamalic and dermatologic function. Initiate studies to define the mechanism of action and pharmacokinetics of existing CW pretreatment and treatment compounds to develop the scientific basis for enhancing drug action. Define and develop standardized animal models for evaluating the mechanisms and sequence of effects of CW agents; special consideration is given to establishing a scientific basis from which to predict potential effects in man. Initiate study to define the methodology and technology required to investigate the pharmacokinetics, physiology, and mechanisms of action of cutaneously applied substances.

Technical/Scientific Area: #02
Project: #BS10
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Combat Casualty Care Research
Title: Research on Military Diseases, Injury and Health Hazards
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

3. (U) FY 1981 Planned Program: Expand investigations to define biochemical, structural and physiological factors involved in wound healing. Continue investigations of host response to injury and infection. Continue assessment of discovery that serum from burn patients inhibits the ability of white blood cells to destroy bacteria. Further define the gastrointestinal alterations and complications to the combat injured. Expand the pulmonary physiology science base and determine mechanisms of inhalation injury. Expand investigations to provide the pharmacologic basis for anti-shock drug development. Continue science base development in support of resuscitative fluid development. Evaluate new techniques to assess the influence of fluid resuscitation on the hemodynamic response to thermal injury. Continue defining the mechanisms of action and the pharmacologic and toxicologic sequence of effects of CW agents, to include identification of biologic markers for the site of action and kinetics of CW poisoning. Continue efforts in defining the mechanisms of action and pharmacokinetics of CW pretreatment and treatment drugs to develop the scientific basis for enhancing the action of selected drugs and formulating new candidate compounds. Continue to develop and expand the programs in standardized animal models for evaluating the mechanisms and sequence of effects of CW agents. These models are critical to the uniform assessment of the efficacy and safety of antichemical drugs intended for use in man. Initiate investigations to define the effects of non-lethal exposures to CW agents on the physiologic compensatory mechanisms for heat, cold and dehydration. Expand investigative dermatologic studies to include defining the effects and mechanisms of action of cutaneously applied CW agents, chemoprotective, and chemotherapeutics. Personnel to be utilized: 83 professional and 104 support.

4. (U) FY 1982 Planned Program: Initiate programs to further assess the biochemical, morphological and physiological factors involved in wound healing to provide basis for development of techniques to improve healing. Continue basic science efforts directed toward inhalation injury and alterations in pulmonary function. Further investigate the pharmacologic mode of action of candidate anti-shock drugs. Expand the biochemical basis of cell-free, oxygen-carrying fluids and other resuscitation fluids. Further define the altered immune response to trauma. Continue to expand the basic science research efforts toward improving the medical defense capabilities against chemical warfare agents.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable.

Technical/Scientific Area: #02
Project: #BS10
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Combat Casualty Care Research
Title: Research on Military Diseases, Injury and Health Hazards
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	2923	4050	5443	6193	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	2932	5067	5117	-	Continuing	Not Applicable

The $9 reduction in FY 1979 was the result of minor funding adjustments near the end of the fiscal year to make maximum utilization of available funds. The FY 1980 funds for the research as shown in the FY 1980 submission were in projects: BS01, ($2000), BS02 ($1842), BS05 ($775), and A71A ($450). The $1,017 reduction in FY 1980 is due to the Congressional appropriations reduction in program element 6.11.02.A ($1,000), the Congressional directive to reduce travel ($7), and the Congressional directive to reduce service support contracts ($10). The FY 1981 estimates as shown in the FY 1980 submission were in projects: BS01, ($2320), BS02 ($2277), BS05 ($0), and A71A ($520). For FY 1981 the increase of $326 over the FY 1980 submission is needed to respond to increased priority and expanded effort for chemical defense research.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #03
Project: #BS10
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Systems Health Hazard Research
Title: Research on Military Diseases, Injury and Health Hazards
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This scientific area was created when Project BS10 was structured. The science base of this program is maintained to establish methodologies, research procedures and instrumentation technology to support research aimed at medical assessment of and prevention of health hazards generated by military hardware systems and/or adverse environments. Basic research focuses on health hazards of military materiel and on medical factors which limit soldier effectiveness. Physiologic studies attempt to define the physiologic responses and behavioral decrements which result from adverse environments (heat, cold, and high altitude), or operation of weapons systems (toxic gases, blast overpressure, vibration, impact and noise) which limit performance (exercise, physical fitness, continuous operations, rapid translocation and combat stress), or which affect special senses or organ systems (auditory, visual, pulmonary, nervous and cardiovascular). Neuroscience studies focus on the phenomenology and mechanisms of action which prevent dysfunctional behavior and reduce psychiatric morbidity (epidemiology, psychiatry, social work and anthropology), which enhance the soldiers' ability to cope with combat stress (social and experimental psychology) and which prevent psychophysiologic or psychosomatic breakdown (neurophysiology, neuroanatomy, neuroendocrinology, neurochemistry, neuropharmacology, neurology and psychophysiology). Required disciplines for assessment of Army-unique (e.g., smokes/obscurants) toxic chemical hazards (toxicology, pathology, biochemistry, physiology and pharmacology) and specialized technologies for microwave, millimeter wave and laser research (physics, engineering, research psychology, histology, pathology, neurophysiology, biophysical chemistry and molecular pharmacology) are supported at a basic science level.

B. (U) RELATED ACTIVITIES: Efforts for this scientific area were previously funded under Projects BS01, Basic Research on Military Injury and Diseases; BS02, Basic Mechanisms of Recovery from Injury; BS07, Helicopter, Combat Crew and Airborne Medicine; and BS08, Environmental Stress, Physical Fitness, and Medical Factors in Military Performance. This research provides the basic science core in support of exploratory development for Program Element 6.27.77.A, Systems Health Hazard Prevention Technology. This program was consolidated and restructured to utilize existing technologies better.

C. (U) WORK PERFORMED BY: In-house research is conducted by the Walter Reed Army Institute of Research, Washington, DC; US Army Aeromedical Research Laboratory, Fort Rucker, AL; US Army Research Institute of Environmental Medicine, Natick, MA; Letterman Army Institute of Research, Presidio of San Francisco, CA; and US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD. The top five contractors are: University of New Mexico, Albuquerque, NM; JAYCOR, Del Mar, CA; Oak Ridge National Laboratories, Oak Ridge, TN; Medical College of Virginia, Richmond, VA; and Science Applications, Inc., McLean, VA. There are eight additional contractors at a cost of $642,000.

Technical/Scientific Area: #03
Project: #8S10
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Systems Health Hazard Research
Title: Research on Military Diseases, Injury and Health Hazards
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Developed animal models and energy source simulators for physiologic hazard assessment of stead, state noise, blast overpressure, vibration, hypothermia, cold injury and acute mountain sickness. Determined the effects of preinduced hyperthermia and hypothermia on laboratory animals' abilities to survive and perform in the heat. Developed models for laboratory simulation of military performance for assessment of combat effectiveness, physiologic/psychologic cost and physical fitness factors. Developed isolated liver perfusion system for the study of heat induced liver cell damage and techniques to study the pathophysiologic mechanisms in endotoxemia (toxins in the bloodstream) and heat stroke syndrome. Discovered that a specific neurochemical blocking agent (naloxone) prevents death from endotoxic shock and shock associated with severe blood loss. Initiated literature review to develop a battery of short-term toxicologic tests for prediction of chronic health effects. Developed technology base for study of low level laser effects and cellular level effects of microwave exposure. Established data base on hearing loss produced by low frequency noise.

2. (U) FY 1980 Program: Maintain biomedical capability for studies on mechanisms of adaptation to environmental extremes and physical exertion. Explore the role of endotoxins and/or bacterial invasion in heat stroke. Assess heat induced liver injury and evaluate liver protective agents. Determine the efficacy of intravenous albumin administration as a plasma volume expander and as a method of artificial heat acclimatization. Compare airway and external methods of rewarming hypothermic casualties. Explore the mechanisms of impaired oxygenation in soldiers breathing supplemental CO_2 at high altitudes. Develop new tests for measuring and evaluating the anaerobic power component of physical fitness. Continue development of data bases for interactive exposure to vibration and noise, mechanisms of hearing loss, visual physiology, and neurophysiology of night vision and visual acuity. Develop large animal models for study of low frequency hearing loss. Characterize neurophysiologic mechanism by which naloxone prevents irreversible shock. Develop neurophysiologic models for studying neuronal populations to examine the effects of toxic substances and chemical agents on the brain. Complete literature reviews on pulmonary, renal, hepatic, cardiovascular and nervous sytems toxicology; recommend short-term test battery for each organ system. Develop advanced millimeter wave assessment technologies.

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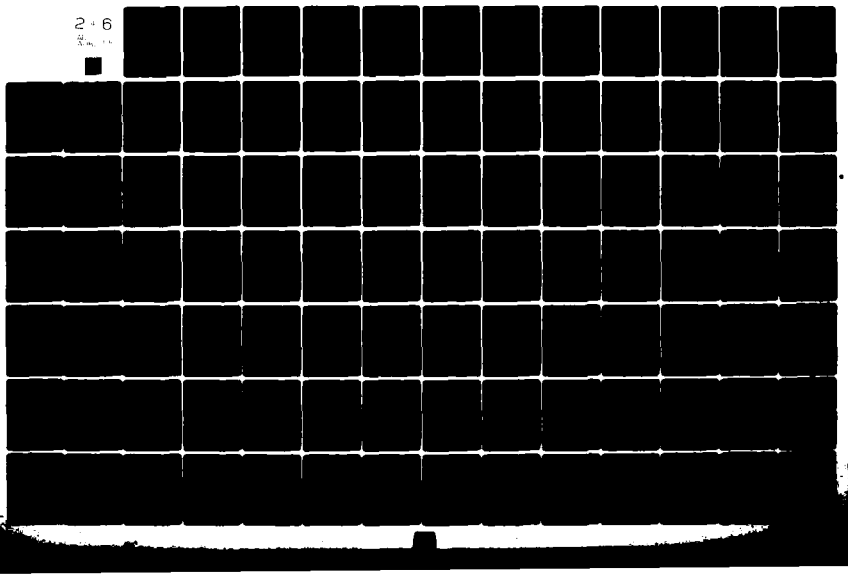

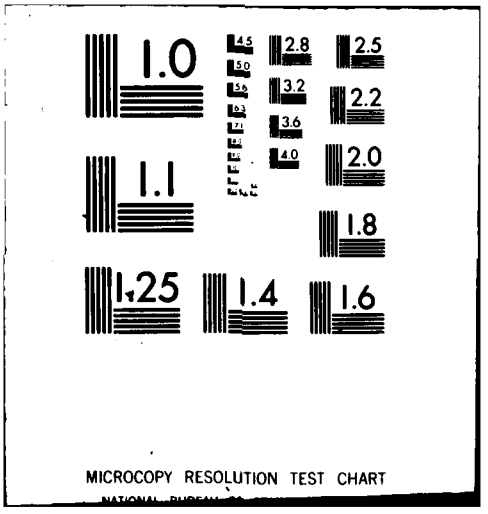
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MICROCOPY RESOLUTION TEST CHART

Technical/Scientific Area: #03
Project: #BS10
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Systems Health Hazard Research
Title: Research on Military Diseases, Injury and Health Hazards
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

3. (U) FY 1981 Planned Program: Describe physiologic mechanisms of heat and cold injury and demonstrate new approaches to treatment. Define the neural mechanisms of peripheral temperature regulation and investigate techniques/procedures for influencing them. Develop an experimental animal model of high altitude pulmonary edema. Examine the influence of high altitude on wound healing in animals. Develop human models to study mechanisms of hearing loss, vibration effects on body systems and multi-axis exposure criteria to vibration. Conduct basic studies in visual neurophysiology. Develop biologic markers for acute lung injury from blast overpressure. Develop a functional neuroanatomical technical base in support of drug abuse and toxic hazards research. Conduct animal studies to examine stress and fatigue effects on vigilance/attention during continuous operations. Begin validation of short-term toxicology tests for development of a comprehensive battery. Apply advanced millimeter wave technologies to determine bioeffects in cells and cell-free suspensions. Develop bioeffects data base for potential hazards of new generation candidate lasers. Personnel to be utilized: 94 professional and 117 support.

4. (U) FY 1982 Planned Program Develop predictive noninvasive indices for improved diagnosis and treatment of cold injuries. Develop a battery of work tasks for use at sea level which will enable prediction of soldiers' ventilatory responses at altitude. Develop laboratory model of military physical performance tasks. Improve techniques for developing muscle strength. Develop modeling techniques to determine human indices of tolerance and exposure to vibration, optical and acoustic hazards. Refine parameters affecting human spatial visual capabilities. Initiate stress neurochemistry studies for prevention of combat psychiatric casualties, or performance impairments due to extended sleep loss, continuous performance demands, low level toxic substance exposure and certain neurologic injuries. Continue toxicology test battery development to reduce long-term mammalian toxicity testing requirements. Validate and refine methods to determine cell membrane mediated effects produced by millimeter wave absorption.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable.

Technical/Scientific Area: #03
Project: #BS10
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Systems Health Hazard Research
Title: Research on Military Diseases, Injury and Health Hazards
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	5145	5403	6587	7516	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	5145	5420	6139	-	Continuing	Not Applicable

The FY 1980 funds for this research as shown in the FY 1980 submission were in projects: BS01, ($2500), BS02 ($500), BS07 ($399), and BS08 ($2021). The $17 reduction in FY 1980 is due to the Congressional directive to reduce travel ($9) and the Congressional directive to reduce service support contracts ($8). The FY 1981 estimates as shown in the FY 1980 submission were in projects: BS01 ($2900), BS02 ($600), BS07 ($417), and BS08 ($2222). For FY 1981 the increase of $448 over the FY 1980 submission will provide for integration of the science base for health hazard assessment research and an expansion of research to address recently recognized shortfalls.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A31B — Title: Night Vision and Electro-Optics Research
Program Element: #6.11.02.A — Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research — Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The Army must improve its ability to fight during periods of darkness and limited visibility. The objective of this project is to exploit new concepts for passive and active infrared detectors and imagers, new lasers, smart sensors, digital image processing, target signatures, and atmospheric modeling. The promising results of this project will be reduced to practice in exploratory development of day/night vision and tracking systems. Research on low-cost, uncooled thermal imaging concepts is conducted to permit electro-optical target acquisition device solutions to such diverse high-volume Army requirements as day/night riflesights, crew-served weapon sights, infrared drivers' and pilots' viewers and terminal homing seekers. This research emphasizes studies of lasers, pyroelectric materials, charge coupled device imagers and thermo-optical imaging concepts. Research on monolithic elements for far infrared focal plane arrays is directed at low-cost, high-performance thermal imaging requirements such as long-range surveillance forward looking infrared devices and fire-and-forget autonomous seekers. Research addresses materials studies of 3-5 micron and 8-10 micron monolithic mercury cadmium telluride focal planes. The 1-2 micrometer image intensifier program contemplates a ten- to twenty-fold improvement in photosensitivity over third generation image intensifiers. This program capitalizes on the high levels of night sky glow emission in the 1-2 micrometer region and the high level of target contrast available. 1-2 micron imagers have the further important characteristic of providing more effective target camouflage penetration. Smart sensors and autonomous seekers are technology areas of intense military interest and importance. Research is required on automatic target acquisition algorithms or rules applicable to imaging seekers and multispectral cuers. Research is also required as a basis to advance critical military areas such as advanced target trackers and very high bandwidth compression for data links. The program on near millimeter wavelength lasers is directed toward the eventual development of laser radars and imagers operating near one millimeter to provide all-weather battlefield surveillance and target acquisition capability.

B. (U) RELATED ACTIVITIES: Close coordination is maintained with the Navy, Air Force, and Marine Corps, other government agencies, academia, and industry to avoid duplication. Through the Joint Logistics Commanders, coordinating groups have been established to ensure that maximum use is made of limited assets, e.g., Navy is developing 3-5 micron second-generation infrared detectors, while the Army is developing infrared detectors sensitive to 8-14 micron energy and uncooled detectors. The Air Force is working on extrinsic silicon technology of infrared detectors. 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.

C. (U) WORK PERFORMED BY: This work is performed by the Night Vision and Electro-Optics Laboratory, Ft Belvoir, VA. The top five contractors are: Rockwell International, Thousand Oaks, CA; Hughes Research Corp., Malibu, CA; Honeywell Incorporated,

Project: #A31B
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Night Vision and Electro-Optics Research
Title: Defense Research Sciences
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Minneapolis, MN; Westinghouse Electric Corp., Baltimore, MD; and Radio Corporation of America, Burlington, MA. There will be nine additional contractors receiving approximately $2,600,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: A revolutionary uncooled imaging approach was conceived; theoretical performance analysis was carried out that indicated uncooled performance levels at or exceeding current thermal systems now going into production are possible. Uncooled systems offer the advantage of considerable reductions in systems costs and size by virtue of the elimination of cooling requirements. The field assisted 1-2 micron photocathode has demonstrated 8% quantum efficiency at 1.6 microns which is the spectral window that provides the strongest reflective target/background signature from the night sky and during poor atmospheric conditions (e.g. haze, fog). The multiplicity of spectral windows in the 1-2 micron region makes it impossible to camouflage targets against all expected backgrounds by use of spectral correlation techniques. This also makes the 1-2 micron region a good candidate for smart sensors. Imaging of the photoemission has been demonstrated in the laboratory with 0.1% quantum efficiency. A 1-2 micron (gallium arsenide-antimony) linear charge coupled device has demonstrated 99.9% transfer efficiency. This approach to 1-2 micron imaging offers the promise of a simpler, more sensitive 1-2 micron sensor. A gallium arsenide charge coupled device with 99.95% transfer efficiency has been shown to be radiation hard under neutron and gamma doses significantly more than the best silicon state-of-the-art. Techniques for automatic control of forward looking infrared (FLIR) device gain, brightness, and focus and for enhancement of FLIR imagery have been generated. Algorithms for automatic acquisition of targets have been tested by computer simulation on FLIR imagery and show 95% detection and 50% recognition at 3- to 4-line pairs per target height. Extensions of these approaches toward lower false alarm rates (currently 1 per forward looking infrared device frame) and detection at 1 to 2 lines per target height have begun for eventual application to autonomous weapons. Techniques for up to 1000:1 image compression have been generated for significantly enhanced antijam margins for remotely piloted vehicles and remote battlefield surveillance networks. An aerosol scattering model has been developed in order to evaluate how clouds and smoke affect performance of day/night viewing devices. A preliminary target viewer background thermal signature model has been developed to help predict sensor performance under all weather conditions, and critical data base gaps related to further development of this model have been identified. A concept of lateral collection for infrared detectors has produced impedance detectors which are highly compatible with charge coupled device signal processors. Such compatibility is required for the development of focal plane arrays. Work is ongoing on a monolithic 8-14 micron staring (nonscanning) sensor based on materials from the periodic groups III-V and II-VI, which will have sufficiently high sensitivity that, when combined with on-chip image processing, will provide significant improvement in countering poor weather and smoke. Extensions of the approach will allow, in one sensor, capabilities in all spectral bands from 1 micron to 14 microns so that with a broad band tunable filter, a multisensor for smart sensing, all-weather operation

Project: #A31B
Program Element: #6.11.02.A
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Title: Night Vision and Electro-Optics Research
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will be possible. Miniature low-cost laser cavity effort using neodymium pentaphosphate for mini-rangefinder application was completed and transferred into the 6.2 program. A derivative program using this material for a low-cost target marker is being pursued. Sixteen dyes for Q-switching at 1.7 and 2.06 microns have been synthesized and are ready for evaluation. The theoretical effort on solid state laser materials has been temporarily terminated and shifted towards build-up of an automatic test facility which will provide all necessary parameters for the second generation laser materials. Evaluation and comparison of methods to frequency stabilize carbon dioxide lasers by injection locking have continued. Results were applied to the design and construction of modular carbon dioxide lasers for forward looking infrared integrated rangefinding, infrared startle designation and crosswind sensing. Baseline physics for development of periodic table group III-V compatible integrated optics application are being developed; materials suitable for 10.6 micron integrated optics structures are being explored. Optically pumped lasers, in both the superradiant and the unstable modes in the near millimeter wave region have been operated. Several new concepts of cavity feed have been explored and results close to theoretical limits obtained. Definition of alternate electro-optical source concepts have been established.

2. (U) FY 1980 Program: A single element scaled-up uncooled detector is being demonstrated to prove the basic theory of the new uncooled imager approach. Imaging of a linear 1-2 micron charge coupled device (100 pixels) is being evaluated to validate the promise of 80% quantum efficiency by this approach. Advanced automatic image target acquisition and tracking approaches for autonomous munitions are being generated and analyzed to provide operation in highly cluttered, low signal to noise, multitarget environments. Investigations will begin this year on approaches to achieving image compression ratios of 10,000:1. Studies of battlefield and vehicular acoustic signatures will also begin to determine if use in passive identification friend or foe is possible. Scaling laws to predict tank or other armor overhead signatures for high-angle attack weapons effectiveness studies are being developed using the current signature data base. As an initial step toward total computerization, a computerized directory is being developed for the Army-Wide Target Signature Data Base. A framework of smart sensor technology is now being acquired in order to develop performance models for a broad class of sensors with wide applicability. Bulk cadmium telluride materials are being made available with sufficient quality that the monolithic 8-14 micron staring sensors can be realized. Charge transfer in a charge coupled device, based on cadmium telluride, is being assessed as the first step in the 8-14 micron monolithic sensor. Performance of two micron saturable absorbers is being optimized and the results will be transferred to rangefinder, designator, and tracker programs for training aids and other "eyesafe" application. An effort to explore miniaturized laser logical elements, high-speed integrated optical processing and micro-integration electro-optical devices will be initiated. Research includes gas chemistry and contamination mechanisms which impact on laser performance, reliability, and lifetime. Baseline physics for development of periodic table groups III-V compatible integrated optics applications and exploration of material suitable for 10.6 micron integrated optics continues. Presently some effort is being made to determine feasibility of laser driven traveling wave sources (i.e., free electron laser,

Project: #A31B
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Night Vision and Electro-Optics Research
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laser action achieved by second harmonic generation, and electrical discharge laser) if supported by preliminary analysis. Work on an optically pumped laser unstable resonator configuration to maximize pumping efficiency and mode control is nearing completion. We will also explore new molecular gases predicted for high near millimeter wave output and fabricate small arrays of planar waveguides coupled with Schottky detectors which operate in a heterodyne mode and measure receiver operating characteristics.

3. (U) FY 1981 Planned Program: A simple imager (64 x 64 pixels) will be demonstrated to assess the thermal/optical crosstalk in the sensing and readout mechanisms. Linear (100 pixels) 1-2 micron charge coupled devices will be optimized for full sensitivity in all 1-2 micron spectral atmospheric windows (out to 1.8 microns). Low noise (noise figure 1.2) on chip readout mechanisms will be established to realize the full sensitivity available. Electrically tunable spectral filters for the 3-5 micron region and for the 8-14 micron region will be evaluated both as band pass and band stop filters. Algorithms for automatic detection of arrays of subresolved targets in infrared imagery will be investigated. Techniques will be generated for tracking of multiple targets with critical aimpoint selection and target prioritization for autonomous weapons. 10,000:1 image compression will be demonstrated by computer simulation. Study of the effect of vehicle self-noise on the use of acoustic detection approaches will begin. Multitarget signature scaling laws representing the existing data base will be developed and computerized. The Army-Wide Target Signature library will be organized under a System 2000 data base management computer. An autocuer performance model will be formulated and used to analyze existing systems; this model will be augmented with a target tracking prediction capability. Long-range (30-40 kilometers) atmospheric propagation models will be developed in order to formulate performance models for airborne sensors. The problems of epitaxial growth of cadmium telluride on mercury cadmium telluride (of the proper band gap for 14 micron response) on graded cadmium telluride will be worked out and evaluated as the second step in the 8-14 micron monolithic sensor. During this fiscal year we will also: continue exploration of miniature laser and electro-optical elements for micro-integrated optical processors; initiate investigative effort to identify novel applications of adaptive optics for phase and amplitude management of tactical laser devices, equipment, and systems; continue investigation to extend the operating performance, reliability, and lifetime of carbon doxide lasers under sealed-off conditions; perfect and extend macro-integrated heterodyne technology and complete the investigative effort; explore integrated laser-detector elements in anticipation of a follow-on effort; establish the critical operating parameters of competing electro-optical source approaches; define suitable array readout techniques such as multiplexing with charge coupled devices; and assess feasibility of integrating these techniques with amplifiers on focal plane. This project will support 88 in-house personnel (58 professional personnel and 30 support personnel).

4. (U) FY 1982 Planned Program: Based upon prior work, a high-performance uncooled imager will be evaluated using optimized thermo-optical research materials to prove the full potential of this approach. A two-dimensional (100 x 100 pixel)

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Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

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Title: Defense Research Sciences
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1-2 micron charge coupled device will be demonstrated with 80% quantum efficiency over the full useful spectral region, with 99.99% transfer efficiency and incorporating a low noise, on chip readout. Broadband, electronically tunable spectral filters will be investigated which can be tuned from 1 to 14 microns. For multispectral sensors this will allow spectral correlation techniques to be applied to the smart sensor problem by exploiting the unique combination of spectral signatures for multiple bands. Approaches toward the automatic collation and fusion of image data from multiple sensor sources (e.g., battlefield surveillance nets and multisensors autonomous seekers) will be investigated. An initial analytic signature model will be developed to predict thermal target and background thermal contrasts. Development of smart sensor models for target screeners and prioritizers will continue; in addition, models to predict performance of synergistic multispectral sensors including acoustic, magnetic, and seismic devices will be formulated. Long range target acquisition model development will continue with analysis of atmospheric turbulence and large-scale target arrays. Complete test structures of the 8-14 micron monolithic sensor will be fabricated and assessed. Schemes for charge injection into the cadmium telluride charge coupled device processors will be studied as well as cooling parameters and readout mechanisms. Investigation leading to advanced laser/electro-optical information processing for low-cost robotized information handling will continue. Fabrication of the breadboard optical processor will be completed. The effort to identify novel applications of adaptive optics for tactical laser devices, equipment, and systems will continue. Also, for FY 1982 we will initiate an investigative effort to determine optimum design approach and techniques to incorporate advanced design compact carbon dioxide lasers in hybrid configurations; continue to pursue near millimeter wave sources which show promise of significant improvements in operational characteristics; and develop small arrays of planar Schottky diode detectors with suitable readout to establish technology base for practical all-weather pseudo-imaging.

5. (U) Program to Completion: This is a continuing program.

5. (U) Major Milestones: Not Applicable

Project: #A31B
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7. (U) Resources ($ in thousands):

RDTE	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
Funds (current requirements)	6100	6494	7600	8780	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	6100	6900	7500	-	Continuing	Not Applicable

The $406 reduction in FY 1980 is due to the Congressional reduction in 6.11.02.A ($400) and the Congressional directive to reduce travel ($6). The increase of $100 in FY 1981 is part of the overall effort to increase our ability to operate in inclement weather conditions.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.21.05.A
Title: Materials
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	11893	13601	12632	12703	Continuing	Not Applicable
AH84	Materials	11893	13601	12632	12703	Continuing	Not Applicable

B. (U) 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, their mission, and support equipment: 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 helicopter gears and drive train components with resultant excessive vibration and costly maintenance requirements; excessive wear and erosion of gun tubes producing short barrel life, inaccurate ballistics performance, and high operational costs; current inventory of ground combat vehicles fabricated from hull and armor materials incapable of defeating long-rod/high-density penetrator munitions; high vulnerability of crew and personnel of ground combat vehicles to wide-angle backface spall generated by antiarmor 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; lack of acceptable levels of reproducibility of ballistics performance of high-density penetrator munitions due to inadequate advanced penetrator core materials; and the unavailability of adequate high strength, lightweight mobile bridging materials.

C. (U) BASIS FOR FY 1981 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 composites, advanced ceramics, adhesives for bonded joints, and coating materials for corrosion prevention. Major thrusts will include development and characterization of high-strength lightweight materials to provide increased mobility/maneuverability for ground combat vehicles and Army helicopters; improved materials, and advanced armor to defeat penetrator munitions; high strength/toughness

Program Element: #6.21.05.A Title: Materials
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

alloys for gun barrels that shoot farther and maintain their accuracy longer; high modulus lightweight materials to withstand high-g (gravity) forces of advanced missiles; significantly improved materials to satisfy growing demand 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 improved maintainability.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	11893	13601	12632	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	11275	13611	13280	Continuing	Not Applicable

The increase in FY 1979 expenditures as shown in the FY 1981 submission over that presented in the FY 1980 submission was applied to support new defense major initiatives in metal-matrix composites for high modulues helicopter components. The decrease in the FY 1981 planned funding as shown in the FY 1981 submission below that shown in the FY 1980 submission is due to the requirement to provide support for higher priority programs. The FY80 decrease is a result of a general Congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.21.05.A Title: Materials
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The work in this program is 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 prototype specimens 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, or operation of Army materiel to satisfy superior performance requirements, to reduce costs of weapon systems acquisition and lifetime ownership cost of weapon systems.

G. (U) 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 a biannual update of the Materials Technology Coordinating Paper and meetings of the Office of the Deputy Under Secretary of Defense Research and Engineering ad hoc Services Materials Laboratories Council. Coordination with the nonmilitary 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.

H. (U) WORK PERFORMED BY: Approximately 70% of the work will be accomplished in-house at the Army Materials and Mechanics Research Center, Watertown, MA; US Army Armament Research and Development Command, Dover, NJ; Natick Research and Development Command, Natick, MA; US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA; and the US Army Missile Command, Huntsville, AL. Primary contractors are: AVCO, Everett, MA; Massachusetts Institute of Technology, Cambridge, MA; HITCO, TRW, Cleveland, OH; Terra Tek, Salt Lake City, UT; Materials Research Lab, Glenwood, IL; Materials Concepts, Inc., Columbus, OH; Drexel University, Philadelphia, PA; Vought Corp., Dallas, TX.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Development of new characterization techniques for composite helicopter blade materials; graphite/aluminum cross-plied doubler plates were fabricated, mounted on CH-47 helicopter transmission housing, and tested. Significant vibration reduction was observed. Determined 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 tracks; development and evaluation of new composite materials compositions for mobile military bridging. Prototype Army helicopter engine blades were fabricated from

high-strength, high-temperature filament-reinforced superalloy composites. Enhancement of aluminum and steel armor against both antipersonnel projectiles and munitions fragments by incorporating Kevlar spall-suppression backup liners. Development of an improved rubber quick-disconnect gasket for refuel operations in arctic climates. Development of camouflage coating materials for the PATRIOT missile radar antenna elements. New organic composite materials compositions were developed to provide lighter weight, high stiffness helicopter drive shafts.

2. (U) FY 1980 Program: Development of improved polymeric, ceramic, and composite materials; alloys of aluminum, titanium, and uranium; determinations of fatigue, fracture, corrosion, environmental deterioration, biodegradation, and fungal attack of military materials; the development of high-density projectile munition materials and fragmentating munitions materials; investigation of structural and radome materials with laser hardening characteristics; further development of electroslag remelted and maraging steels; 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; development of solutions to technical problems associated with composite materials processing and bonding; and determination of laser protection levels provided and required by combat uniform materials. Work will be initiated under the metal matrix composites major thrust to develop and evaluate formulations for use in fabricating lightweight mobile bridging components. The task on advanced materials formulations for improved armor for Army ground combat vehicles will be significantly expanded.

3. (U) FY 1981 Planned Program: Weapon systems structural work will continue to concentrate on the rheocast fabrication process to exploit cost reductions, on evaluating environmental effects on magnesium protective coating systems, and on improved adhesive bonding for advanced weapon systems. Correlate structural properties and component performance on military vehicle gear and bearing materials. Improved penetrator materials formulations of extruded uranium and tungsten alloys will be fabricated and tested. Fragmentation test will be conducted for cylinder materials machined for 105mm and 155mm projectiles. Effects of thermal stresses and various gaseous environments on cracking nucleation and crack propagation in layers formed during use of gun tubes will be investigated. Textured materials for armor application will be subjected to ballistic firings and analysis. Work will be continued on powder metallurgical processes with aluminum alloys and strain-hardenable aluminum-magnesium-lithium alloys for helicopters. Assessment and design guides for use of foamed materials formulations 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 fuzed 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 alumium alloys. Bridging materials work will be focused on fiber-reinforced organic and metal-matrix composite materials, lightweight metallic components, and design of shafting, truss, and coupling members. Rapid-cure thermosetting resin-based

Program Element: #6.21.05.A Title: Materials
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

composites, continuous fiber-reinforced thermoplastics and improved lightweight impact resistance structural foams components will be developed for improved prototype tank track and suspension system materials. 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 and evaluated. The new major thrusts in metal-matrix composite and advanced formulation armor materials will be continued. Increased emphasis will be placed on materials processing research and development. Personnel supported: 87 professional; 81 support.

4. (U) FY 1982 Planned Program: Selected tasks initiated in FY 1980 and FY 1981 will be completed. The make-up of the FY 1982 program will depend strongly on the primary Army technology base guidance document, the Science and Technology Objectives Guide. As a supplement to the Science and Technology Objectives Guide, advanced program analysis and charting procedures will be used to assess the severity of the problem, the potential benefits to be derived and the probability of success of planned programs. Major emphasis will be placed on the flow of materials technological advancement from Exploratory Development, to Advanced Development, and processing on to manufactoring technology. As a result of the above planning methods, the following high-priority programs have been identified as the basis for the planned program: metal matrix composites for transmission housing and bridging; processing and characterization of organic materials and composites; advanced vehicular armor materials; penetrator materials and penetration mechanics; armored vehicles track and suspension materials; fragmentation shell materials and mechanics; structural integrity, nondestructive testing, and reliability; advanced gun-tube materials and concepts, high-performance gear, bearing, and engine materials; and life prediction mechanics.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.21.11.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

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

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	4900	5947	6717	6853	Continuing	Not Applicable
AH71-A	Automatic Meteorological Technology	399	456	438	600	Continuing	Not Applicable
AH71-C	Atmospheric Characterization	1783	2668	3430	2991	Continuing	Not Applicable
AH71-D	Remote Atmospheric Sensors	1290	1023	896	1340	Continuing	Not Applicable
AH71-E	Atmospheric Models for Electro-Optical Systems	877	1008	1163	1290	Continuing	Not Applicable
AH71-F	Meterological Techniques for Artillery	551	792	790	632	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Mission needs respond to: (1) Requirements contained in Department of Defense (DOD) Atmospheric Transmission Plan, 26 Jul 79, which the Army must meet to satisfy its responsibilities to all three services (Army, Navy, Air Force); (2) requirements from Deputy Under Secretary of Defense for Research and Engineering, 1 Feb 79, for the Army to take the lead providing meteorological support, both technical base (6.2) and meteorological operational support (6.5), to the DOD National High Energy Laser Test Range at White Sands Missile Range, NM. and (3) a requirement for the Army to provide its own weather support forward of Division for weapon systems, and for hydrologic and flood forecasting. This program addresses the urgent need to develop meteorological techniques and equipment essential in the planning and support of combat operations. The impact of weather and battlefield conditions (dirty battlefield) on sophisticated weapon systems employing Electro-Optical (E-O) and near millimeter wave (NMMW) devices must be determined. Meteorological conditions can seriously effect tactical operations. Near real-time weather intelligence is essential in planning combat operations and direct support of weapons systems. Remote wind sensors are required to increase the standoff range (and survivability) of both attack helicopters and battle tanks. Specific objectives are to develop: (1) Meteorological techniques and equipment for direct and indirect support

Program Element: #6.21.11.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Title: Atmospheric Investigations
Budget Activity: #1 - Technology Base

of Electro-Optical (E-O) and target acquisitions systems, armor, smoke, high energy laser (HEL), and artillery precision guided munitions; (2) E-O atmospheric propagation and optics computer codes for determining effects on E-O systems; (3) quantification of potential battlefield environments at wavelengths from visible to near millimeter (NMW); and (4) remote atmospheric sensors to increase armor, artillery and helicopter fire control accuracy increasing the probability of first round hits.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Complete, validate, and distribute advanced European battlefield obscuration models (Advanced Electro-Optical Systems Atmospheric Effects Library). These will give the Army well-documented, validated computer simulations of dirty battlefield environmental effects on the performance of electro-optical/near millimeter wave sensors. Conduct measurements of slant path infrared transmission under low visibility conditions in support of COPPERHEAD. Develop techniques for predicting atmospheric conditions at DOD National High Energy Laser Test Range, White Sands Missile Range, NM, for high energy laser tests. Integrate battlefield obscuration into automated weather data base to describe battlefield environment for electro-optical systems. Complete advanced sound ranging technique for Field Artillery. Field test prototype tank gunnery crosswind sensor to determine the accuracy gain of tank main gun fire using this system vs the current point wind sensor aboard the XM-1 tank.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimate Cost
RDTE					
Funds (Current Requirements)	4900	5947	6717	Continuing	Not Applicable
Funds (as shown on FY 1980 submission)	5703	5960	5582	Continuing	Not Applicable

Funding decrease in FY 79 ($803) resulted in sharply reduced efforts in: automated meterological techniques for battlefield environment for electro-optical systems; meterological techniques for artillery; portable visiocellometer; vertical structure of European fog/haze; and optics library and data analysis due to low priority of requirements for these efforts. FY 80 decrease ($13) is due to a general Congressional reduction applied to this program and will result in a small reduction in automated meteorological techniques. Funding increase in FY-81 ($1135) will address: atmospheric effects on Army short-haul, millimeter wave tactical communications; atmospheric effects on Army priority-thrust system (e.g., Assault Breaker, Sense and Destroy Armor); European battlefield obscurant experiment with PM Smoke; and accelerated development of long range wind system for artillery.

Program Element: #6.27.19.A
DOD Mission Area: #523 - Engineering Technology (ED)

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

E. (U) OTHER APPROPRIATION FUNDS: Not applicable

Program Element: #6.21.11.A Title: Atmospheric Investigations
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Develop techniques and equipment for meteorological support of Army battlefield operations and for design, development, operation and employment of: weapon systems that use electro-optical (E-O)/near millimeter wave (NMMW) sensors, armor, artillery, Precision Guided Munitions (PGMs), smoke, and high energy lasers (HEL). Develop E-O atmospheric propagation and optics codes for determining total battlefield environment effects on E-O/NMMW systems. Identify and quantify battlefield environments. Develop remote atmospheric sensors in direct support of weapon systems, especially armor, helicopter and artillery. Objectives of this program will be accomplished by sophisticated field measurements of atmospheric aerosols preparation of E-O sensor atmospheric effects information data for battlefield zones of Europe, Mid-East, and the cold regions typical of Northern Europe which can be used to determine atmospheric effects on E-O and near millimeter wavelength (NMMW) systems; use of remote sensors, such as crosswinds sensors for armor, antiarmor and helicopters; development of predictive models for battlefield smoke and obscuration; and the development and evaluation of equipment and techniques to account for meteorological effects on battlefield effectiveness of Army artillery and target acquisition systems.

G. (U) RELATED ACTIVITIES: Program Elements 6.11.02.A, Atmospheric Sciences; 6.27.30.A, Cold Regions Engineering Technology; 6.37.41.B, Meteorological Equipment; and 6.57.02.A, Support of Development Testing. Work is coordinated within the Department of Defense by (DOD) the Under Secretary of Defense Research and Engineering (USDRE). Direct coordination is maintained with: Project Manager, Smoke/Obscurants; Army Materiel Systems Analysis Agency/US Army Training and Doctrine Command; Harry Diamond Laboratory; High Energy Laser Systems Project Office/Missile Command, Test and Evaluation Command, White Sands Missile Range (WSMR); Dugway Proving Ground; Air Force; Navy; National Oceanographic and Atmospheric Agency; Environmental Protection Agency; Panel XII (Meteorology) of the NATO Army Armanents Group and the US Army European Mesometeorology Advisory Panel to exchange information and preclude duplication of effort.

H. (U) WORK PERFORMED BY: The Atmospheric Sciences Laboratory, White Sands Missile Range, NM, is the in-house developing organization responsible for the program. Of the $5.95M program in FY 1980, approximately 60% is in-house and 40% is contractual. Contracts exists with the following Physical Science Laboratory, New Mexico State U. Las Cruces, NM; Raytheon Co., Wayland, MA; Stanford Research Institute, Menlo Park, CA; Particle Measuring Systems, Boulder, CO; Oregon Graduate Center, Beaverton, OR; H. E. Cramer Co, Inc; Salt Lake, UT; TRW, Redondo Beach CA; and Science Applications, Inc, Ann Arbor, Mi. Twenty-two additional contracts total $1.164M.

I. (U) PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Completed and distributed interim European battlefield obscuration model for Army users to provide a computer simulation of battlefield environment effects on electro-optical (E-O)/near-millimeter wave (NMMW) sensors in European scenarios. Characterized and modeled dust and debris cloud growth from high energy burst and artillery firing for combat environment models used in one-on-one or force-on-force war games. Conducted low visibility infrared transmission

measurements and dust/smoke field experiment to provide data base, deficiencies and validations for combat modelers. Completed DOD National High Energy Laser (HEL) Test Range measurement system for gases and particulates. Demonstrated sound ranging and smoke expenditure reduction models for artillery and PM Smoke. Continued electro-optical (E-O) research for central Europe to provide information on occurrence of adverse weather conditions to systems performance analysts and combat modelers. Designed/fabricated infrared optical remote crosswind sensor as part of a multisensor for tanks. Developed techniques for automating the recording of sound arrival times on sound ranging equipment to provide the Army with an improved passive target acquisition capability. Initiated techniques for electro-optical (E-O) systems deployment/employment for Intelligence Preparation of the Battlefield. Completed survey of available remotely piloted vehicle (RPV) sensors and systems and analyzed their relationship to potential meteorological applications. FY 79: In-house $3.079, contractual $1.821.

2. (U) FY 1980 Program: Construct E-O sensor atmospheric effects library for Europe and provide computer simulation of the battlefield environment for Electro-Optical (E-O) and Near-Millimeter Wave (NMMW) systems to give an advanced computer simulation of dirty battlefield environmental effects on E-O and NMMW Sensors for European scenarios. Conduct field measurements for dust and smoke validation tests and infrared (IR) and NMMW transmission through dust and smoke for weapon systems performance analysts and combat modelers. Demonstrate exploratory development models for tank gunner crosswind module. Evaluate the short range helicopter remote sensor mounted on the AH-1 helicopter. The sensor will improve helicopter firing accuracy at increased standoff range thereby increasing helicopter survivability and effectiveness in combat. Utilize prototype visibility and cloud base sensor (visioceilometer) in tests to characterize visibility for E-O sensors. Provide atmospheric characterization for outlying high energy laser (HEL) test sites in support of Department of Defense (DOD) National HEL Test Range. Complete solution for Tactical Fire Direction Center (TACFIRE) smoke and chemical application to convert smoke related factors, such as munition expenditure rates, to chemical applications and integrate such codes into field computer systems. Evaluate Remotely Piloted Vehicle (RPV) meteorological sensors for Electro-Optical (E-O) atmospheric characterization. Complete techniques for use in tactical weather intelligence for Intelligence Preparation of the Battlefield. FY 1980: In-house $3.552M, contractual $2.395M.

3. (U) FY 1981 Planned Program: Complete and distribute final European battlefield obscuration model: Army benefits are a well-documented, validated computerzied European battlefield environment simulation model for design, analysis and trade-off studies for E-O and NMMW weapons systems. Complete dust and smoke validation tests for weapon systems performance analysts and combat modelers. Continue field measurement for slant path Infra-red (IR) transmission under limited visibility conditions to enhance weapons system performance (such as COPPERHEAD). Complete sound ranging automation, optimizing sound ranging techniques, and provide to Army Artillery for validation. Develop techniques for predicting crosswind, optical turbulence, extinction coefficient, and transport and diffusion at the DOD National High Energy Laser Test Range, WSMR and complete site chaacterization from surface to 3000 meters. Validate techniques to utilize a meteorological sensor aboard an RPV for E-O atmospheric characterization. Utilize Atmospheric Sciences Laboratory transportable atmospheric characterizaion station and the Harry Diamond Laboratory mobile measurement facility to obtain NMMW propagation data under adverse weather conditions and dust storms. Program

Spectrophone and liquid (droplet) water content systems will be fielded to measure smoke, dust, and fog content in both US and European environments. Field test prototype tank gunnery crosswind module to determine the accuracy gain of tank main gun fire using this system vs the current point wind sensor aboard the XM-1 tank. Continue adaptation of mesoscale meteorological information E-O system utility and demonstrate capability for tactical weather intelligence. FY 81: In-house $4.712M, contractual $2.005M. Number of personnel supported: professional 34; support 21.

4. (U) FY 1982 Planned Program: Construct, validate, document and distribute battlefield obscuration models which provide computer simulation of complex dirty battlefield environments. These models are referred to as the Battlefield Atmospheric and Terrain Transmission Effects Library (BATTEL) will apply to different climatic regions of the globe and will be used to assess effectiveness of electro-optical systems (e.g., COPPERHEAD, HELLFIRE, etc.). Spectral regions covered will range from ultraviolent to radar wavelengths and will address narrow and broadband sources of radiation. Field measurements will be made to characterize the complex battlefield environment composed of natural low visibility conditions, smokes, dust, and debris and the effects of this complex battlefield environment on infrared, near millimeter wave and high energy laser (HEL) propagation. A manual for predicting propagation conditions at the White Sands Missile Range DOD National HEL Test Range will be completed and techniques developed for predicting propagation conditions at outlying HEL sites. Field test radiosonde/ballon system for an improved meteorological sounding system to meet meteorological requirements for future artillery systems. Design potential fluidic sensors for electro-optical atmospheric characterization. Complete, validate and display automated techniques for estimating distribution of battlefield effluents as they effect electro-optical system employment and deployment. Determine optimum zone structure for a significant level wind message for use by long range artillery to improve accuaracy and representativeness of meteorological data. FY 82: In-house $4.273M, contractual $2.580M.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.21.20.A Title: Nuclear Weapons Effects, Near Millimeter Wave, Fluidics
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5793	6636	6505	9014	Continuing	Not Applicable
AH25	Nuclear Weapons Effects Research, Near Millimeter Wave Technology, Fluidics Technology	5793	6636	6505	9014	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The United States Army has the mission of fighting the tactical nuclear battle. The soldier can be effective in the battle even after being exposed to severe nuclear environments. We must design our equipment to be as survivable as our soldiers. The ability of the Army to fight and win the tactical nuclear battle would be seriously degraded if critical equipment failed in the nuclear environment. A Nuclear Weapons Effects Research program is required to assure the survivability of Army materiel during and after a nuclear exchange. Environmental definition, hardening assessment, developing of hardening fixes, and evaluation of the nuclear survivability of operational forces are parts of the program. The approach is to develop and maintain the technology for balanced hardening of fielded and developmental systems. Near Millimeter Wave (NMMW) radars offer a potential way to see through the smoke and obscurants of the modern battlefield. This capability is critical to the Army when fighting outnumbered against an enemy who relies heavily on obscurants for cover in the attack. The NMMW Program provides a much needed data base on transmission and target background reflectivity, in adverse environments, and explores new systems technology. The fluidic technology program provides a coordinated, Army-wide program for the design, development, testing, and feasibility demonstration of fluidic activated control 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. This is a Single Program Element Fund (SPEF) wherein a single Army Laboratory is funded in one Program Element (PE) to perform two or more tasks that are not necessarily related.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Technology will be developed to insure that hardness is maintained during production and fielding of systems. The hardened shelter program will continue. The program to develop vulnerabilities for two critical

Program Element: #6.21.20.A Title: Nuclear Weapons Effects, Near Millimeter Wave, Fluidics
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Intelligence Surveillance Target Acquisition (ISTA) Systems will be expanded. The tactical fire control system (TACFIRE) vulnerability and hardening study will be completed. The Near Millimeter Wave (NMMW) technology base program is required if equipment capable of operating in a limited visibility environment is to be designed. Target/background signatures, measurement techniques, radars, and collection receiver technology will be investigated for NMMW all-weather Army systems. The fluidics program will continue efforts to develop high reliability control systems and environmental sensing devices.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5793	6636	6505	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	5788	6641	9325	Continuing	Not Applicable

In FY 1981 the fluidic exploratory development effort will be reduced as the technology becomes increasingly available in the private sector. Nuclear weapons effects research will be conducted at a diminished level because of higher priority exploratory development efforts. The increase in FY79 funding over the FY80 submission figure is the result of minor, informal reprogramming. The decrease in FY80 is the result of a general Congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.21.20.A Title: Nuclear Weapons Effects, Near Millimeter Wave, Fluidics
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION:

1. (U) 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, and 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.

2. (U) Near Millimeter Wave (NMMW) systems can provide better resolution of military targets than longer wavelength microwave systems. They are less affected by smoke and fog than electro-optic systems. The NMMW Technology Program will fill existing data gaps, develop NMMW measurement standards, and investigate new NMMW all-weather systems.

3. (U) Fluidics offer low maintenance, high reliability, intrinsically safe control systems that can operate in harsher environments than other types of controls, and are adaptive particularly to suspension systems for vehicles, and turret stabilization systems for armored vehicles. This program explores the applicability of fluidics to candidate systems sufficiently to demonstrate the feasibility of transferring technology to system development as cost-effective improvements.

G. (U) 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.A (Advanced Weapons Effects and Nuclear Munitions) which provides for technological assistance to materiel development agencies. All appropriate programs for missiles, combat vehicles, communication systems, and battlefield intelligence systems are supported by these efforts. The NMMW technology program is coordinated with research activities in PE 6.11.02.A and other US Army Electronics Research and Development Command programs. Fluidic technology follows up on research in PE 6.11.02.A, Research in Fluidics, Nuclear Effects, and Ordnance Electronics.

H. (U) 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 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, Schenectady, 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

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DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

Institute, Denver, CO; Lovelace Foundation, Albuquerque, NM; AiResearch Manufacturing Company, Phoenix, AZ; TriTec, Inc., Columbia, MD; and Applied Physics Laboratory, Laurel, MD.

1. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments:

a. (U) A comprehensive electromagnetic pulse (EMP) program was continued under which survivability levels are established for Army single and multichannel radios, repeaters, and telephone terminals. Product improvement proposals to incorporate increased levels of EMP survivability into hardware have been initiated in cooperation with appropriate project managers. The High Altitude EMP vulnerability assessment of selected tactical fire control system (TACFIRE) equipments was continued. Vulnerability assessments on the AN/GRC-142 and AN/TRC-145 radios to confirm the predicted vulnerabilities were initiated. Radiation vulnerability analyses of TACFIRE and communications mobile electric power units were initiated. The first successful low altitude EMP simulation coupling test was completed using a bounded wave transmission line in the Aurora test cell. This test confirmed the response prediction for the AN/PRC-77 radio. The near surface burst EMP environments code production runs were made for Pershing and a Soviet-type warhead. An internal shock spectrum simulator was fabricated, and nuclear blast generated shock spectra were obtained for several communication equipments. A selective shielding approach was developed to reduce radiation vulnerability of vehicles. A method was developed to harden fiber optic cables against blast and thermal effects.

b. (U) The Near Millimeter Wave (NMMW) Technology Program was a new start in FY 1979. The design of the NMMW mobile measurement facility with the Georgia Institute of Technology proceeded on schedule. The mobile measurement facility will be used to characterize target and background signatures in realistic battlefield environments at 94, 140, and 220 gigahertz (GHz). An elementary system for measurement of multipath effects at 94 GHz was designed and built. Near Millimeter Wave measurement standards for 240 GHz were investigated. Fluidic program technology has resulted in the demonstration of fluidic temperature sensors, fluidic vortex rate sensors, fluidic activators for missile control, fluidic control systems for diesel engines, and fluidic power supplies.

c. (U) In FY 1979, field tests were initiated on fluidic fuel controllers for small auxillary power system turbines. Installation and field test of a fluidic gun/turret stabilization system for armored vehicles successfully demonstrated capability equivalent to current, fielded systems. Fluidic temperature sensor development resulted in these sensors being evaluated for primary control in process plants. Technology coordination continued to be emphasized.

Program Element: #6.21.20.A Title: Nuclear Weapons Effects, Near Millimeter Wave, Fluidics
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

2. (U) FY 1980 Program:

a. (U) Nuclear weapons effects hardening fixes for critical equipment from the forward edge of the battle area through Corps will be available in FY 1980. High Altitude electro-magnetic pulse hardening and balanced vulberability analysis will be continued on the tactical fire control system (TACFIRE), and will be initiated on the Intelligence Surveillance Target Acquisition (ISTA) and the Air Defense Command and Control Systems. Balanced hardening fixes will be developed for low, medium, and high capacity multichannel communications systems. The vulnerability analysis and hardening of a mobile electric power unit for selected communications systems will be continued. An effort to harden large computer vans will be initiated. A feasibility study will be initiated for the large area combined blast/thermal nuclear weapons effect simulator.

b. (U) The design and contruction contract of the NMMW Mobile Measurement Facility (MMF) with the Georgia Institute of Technology will continue. Measurement procedures will be formulated and a detailed test plan for the Mobile Measurement Facility will be developed. The system parameters and configuration of a lightweight handheld ground surveillance radar will be defined. System requirements will be determined for an improved near millimeter wave (NMMW) collection receiver. Multipath measurement at 94 gigahertz (GHz) will be made in tactical battlefield scenarios. Frequency and power measurement standards for the 240 GHz frequency range will be developed.

c. (U) Fluidic component development will emphasize the laminar rate sensor/amplifier package as a rate gyro for autopilots and heading reference units. Work will continue on a dual-input servovalve, fluidic resistive thermometry, backup fuel controller, and overall fluidic technology coordination.

3. (U) FY 1981 Planned Program:

a. (U) A program will be initiated to develop techniques to predict the incidence and distribution of tree blow-down and fires in forests as the result of a nuclear explosion. The tactical fire control system (TACFIRE) vulnerability and hardening study will be completed; a similar effort for Intelligence Surveillance Target Acquisition (ISTA) will be expanded. A vulnerability assessment of the Improved Hawk and PATRIOT air defense systems to all nuclear effects will be initiated. Source region electromagnetic pulse (EMP) studies will be completed. General technology efforts will continue with emphasis on vulnerability and hardening and identification of electro-optical device vulnerabilities.

b. (U) The basic near millimeter wave mobile measurement facility for operation at 94, 140, and 220 gigahertz (GHz) will be completed. Transmission and target and clutter/background measurements in adverse environments will be made at tests in Vermont, in Western Europe, and at other locations in the United States. A breadboard model of a very lightweight handheld

94 gigahertz (GHz) ground surveillance radar will be made. A prototype near millimeter wave collection receiver will be designed and construction will begin.

c. (U) Development of fluidic rate sensor/amplifier packages for autopilots and heading reference units will continue. Work on a dual-input servovalve and a backup fuel controller will be completed. Development of fluidic power supplies for pneumatic operation will begin.

4. (U) FY 1982 Planned Program:

a. (U) Experimental techniques for testing Army systems to the effects of low altitude electromagnetic pulse (EMP) will be developed. Efforts to develop the technology to predict a test system for the combined effects of blast and thermal will be continued. Efforts to define the tree blow-down forest fire environment will continue. Radiation and EMP vulnerability of emergency semiconductor ciruits will be determined. The design for a large area blast/thermal simulator will be completed. Vulnerability assessment of intelligence surveillance target acquisition (ISTA) and air defense systems will be expanded to include all effects.

b. (U) The US Army Harry Diamond Laboratories (HDL) NMMW mobile measurement facility (MMF) will be used to make measurements of transmission and of target and clutter background signatures in adverse environments in the United States. The MMF 140 gigahertz (GHZ) transceiver will be modified for coherent operation. Improved antenna and processor requirements will be determined for the very lightweight handheld ground surveillance radar. An alternate frequency NMMW (near millimeter wave) collection receiver system will be designed and built. Multipath measurements will be made at 94, 140, and 220 GHz with the Mobile Measurement Facility (MMF) for various terrains and conditions of tactical interest. A design study will be made and trade-offs investigated for near millimeter wave antiradiation weapon sensors. Measurements standards for determining accurate NMMW frequency/wavelength, attenuation, and power will be investigated.

c. (U) Development of fluidic components for autopilots will be completed. Work will continue on fluidic components for heading reference units and a fluidic power supply for pneumatic operation. Development of fluidic actuators and high-dynamic-range laminar amplifiers will begin.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.22.61.A
DOD Mission Area: #523 - Engineering Technology (ED)
Title: Aircraft Weapons Technology
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1900	2101	1808	2704	Continuing	Not Applicable
DH96	Aircraft Weapons Technology	1900	2101	1808	2704	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program generates concepts and demonstrates the technical feasibility for application of advanced armament techniques and weapons on Army aircraft for delivering ordnance to destroy, neutralize, or suppress enemy targets in the conduct of the land combat campaign. The objective is to provide the greatest possible weapons effectiveness at affordable costs in order to multiply the value of a single system through technology and compatibility with other systems.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Fabrication of a flyable Auto-Cueing device will be completed and an investigation of long-range fire control options for point targeting from helicopters will be initiated. New munition concepts for helicopter weapons to defeat point targets at long ranges to include options for defense against other helicopters will be developed. New concepts for using aerial rockets, including terminal trajectory correction techniques, will also be investigated.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1900	2101	1808	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	1910	2101	2311	Continuing	Not Applicable

Program Element: #6.22.01.A
Title: Aircraft Weapons Technology
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

FY 1979 amount reduced due to reprogramming to higher priority technology program. FY 1981 reduced by Office of the Secretary of Defense (OSD) as part of overall reduction in exploratory engineering programs.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.22.01.A Title: Aircraft Weapons Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Development efforts are directed toward strengthening the technology base of aircraft weaponry to provide the Army with advanced aircraft weapons and improved munitions. Effort is directed towards generating concepts and advancing technology necessary for improved performance and extended life. There are four areas of research and development: weapons system concepts, fire control, aerial munitions, and aerial rockets.

G. (U) 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 and to minimize duplication of effort. 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.

H. (U) WORK PERFORMED BY: Aviation Research and Development Command (AVRADCOM), St. Louis, MO; Armament Research and Development Command (ARRADCOM), Dover, NJ; US Army Missile Command (MICOM), Huntsville, AL; US Army Materiel Systems Analysis Activity (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.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Competitive hybrid constant recoil concepts have been evaluated. Technical determination was made to integrate advanced gun componentry to demonstrate advanced technology. High Impulse Gun Airborne Demonstration (HIGAD) project was completed. This project showed the feasibility of mounting a high-impulse weapon system on an Army helicopter. Included in this effort was the integration of new technology fire control features such as constant recoil, closed-loop fire control, improved stabilization, and precision aiming. The decision was made to pursue future technical advances using testbed designs that address separate loading and telescoping ammunition concepts. processing schemes have been formulated for millimeter wave radar to allow acquisition and tracking of fixed ground targets in a clutter environment. Tower testing is underway to verify fixed target detection. This evaluation established the ground rules regarding radar use on rotary wing aircraft for both air-to-air and air-to-ground application. Optical sight model validation was performed which established a basis for comparison of advanced target acquisition methods with known optical capabilities. Analysis of helicopter air-to-air ballistic dynamics was completed. A firing test using the Multiweapon Weapon Fire Control System (MWFCS) with a dual rate of fire turreted 20mm weapon was completed at Fort Bliss. A comparative cost effectiveness

Program Element: #6.22.01.A Title: Aircraft Weapons Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

study of helborne TOW and SHILLELAGH antiarmor missile systems was completed with the TOW selected as the most effective. Four contenders for a second-generation area weapon were evaluated and the XM230, 30mm chain gun, was selected. Studies were conducted to determine aerial weapon system 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 antiradiation 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. Firing tests with turreted and wing-mounted guns on the AH-1G Attack Helicopter were conducted to identify the different variables contributing to total firing error and magnitude of each error source. The spin insensitivity and penetration potential of a shallow cone-shaped charge warhead were also demonstrated. Firing tests of 2.75-inch rockets with submunition warheads were conducted to investigate the sensitivity of submunitions deployment variations in rocket trajectory. Advanced ammunition concepts in telescoped configuration were investigated for optimization. Automatic target-cueing methodology was evaluated for television and FLIR (Forward Looking Infrared) sensors. A prototype autotarget-cueing system to provide a target detection capability for use with remote view imaging sensors was fabricated and flight testing planned. This effort establishes the basis for the fabrication of a fully operational airborne autotarget-cueing system. Initial work on smoothbore concepts for the high-impulse gun, capable of defeating enemy armor, was initiated. A precision point fire weapon concept using armed Remotely Piloted Vehicles in providing long-range standoff capability against enemy armor and hostile aircraft was pursued. A feasibility demonstration of low-cost radio frequency (RF) target marking system to allow integrated use of cannon and rockets on selected targets was initiated. Design efforts for mass focus fragmentation and secondary trajectory stabilization for submunitions and a fuze wave shaper for small caliber ammunition were initiated.

2. (U) FY 1980 Program: Design of a fire control system compatible with long-range weapons will begin. Benefits gained from mast-mounted sensors, millimeter wave radar, optimal filtering techniques, forward looking infrared (FLIR) and television techniques will be utilized in a long range standoff fire control design which can be integrated with attack helicopter weapon systems. Auto-cueing efforts will yield data necessary to evaluate system effectiveness of optimal filtering techniques. Tactical projectile feasibility investigation will address the application of Spinning Tubular Projectile (STUP) for the antihelicopter role, long-rod penetrators for helicopter weapons, and the development of a lightweight steel cartridge case. This effort will emphasize breadboard hardware and ballistic testing to provide a final engineering package. The terminal trajectory correction effort, correction control items, and signal processor will be designed. Evaluation of the principal option for an imaging armed RPV, addressing sensor package configuration, weapons options and interface, terminal management for ordnance launch, and automatic target-cueing techniques will continue. These exploratory development efforts employ twenty-five professionals at various technical laboratories.

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3. (U) FY 1981 Planned Program: Long-range fire control options such as second-generation Forward Looking Infrared (FLIR) and remote sensing will be investigated. A flyable automatic target-cueing system will be flight tested and improvements defined. Further work on new antiarmor and antihelicopter munitions to be launched from rotary wing aircraft will be completed and various concepts tested. Terminal trajectory correction options for delivery of warheads and radio frequency target marking designs will be field tested.

4. (U) FY 1982 Planned Program: Efforts will be undertaken to address weapon system precision performance concepts. These efforts include such tasks as precision fire control, closed, closed-loop fire control analysis and integration with man both in and out of the loop, and automatic in-flight boresighting of all on-board armament and fire control subsystems. Continuing analyses of air-to-air munitions such as Spinning Tubular Projectile (STUP) and cluster long-rod penetrator will be undertaken. Low-cost smart projectile concepts will be developed by the US Army Armament Research and Development Command (ARRADCOM) and Missile Command (MICOM) for rotary wing aircraft utilization.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.22.02.A
Title: Aircraft Avionics Technology
DOD Mission Area: #521 - Electronic & Physical Science (ED)
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5779	6322	6178	7739	Continuing	Not Applicable
AH85	Aircraft Avionics	5779	6322	6178	7739	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the exploratory development technology base for Army avionics. The primary thrust is to enhance operations of Army helicopters in the known enemy threat environment during day, night, and adverse weather missions. Nap-of-the-Earth (NOE) flight is required for battlefield survivability. In addition to challenging helicopter crews, the nap-of-the-earth environment poses significant technical problems for system and subsystem designers. Areas of investigation include communications, environment sensing, navigation, air traffic management, landing systems, cockpit instrumentation, and digital avionics systems.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: The FY 1981 request is based on the need to seek new solutions to significant tactical short comings in the technical aspects of NOE operations (e.g., communications, sensing, navigation, etc.). The FY81 program will build on earlier successes in the areas of night navigation and pilotage, digital avionics, and system architecture, electronic master monitor advisory system, laser-based detection of wires and other obstacles, navigation systems analysis, attitude, and heading reference system, hybrid navigation systems, tactical landing systems, and tactical air traffic control.

Program Element: #6.22.02.A Title: Aircraft Avionics Technology
DOD Mission Area: #521 - Electronic & Physical Science (ED) Budget Activity: #1 - Technology Base

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5779	6322	6178	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	5768	6342	6977	Continuing	Not Applicable

FY 1979 increase was the result of internal Army adjustments of $11 thousand. FY 1980 program was reduced slightly in order to fund higher priority programs by reducing air traffic management and tactical landing efforts. FY 1981 program was reduced in order to fund higher priority programs with more reductions in Air traffic management, tactical landing efforts and communications.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.22.02.A Title: Aircraft Avionics Technology
DOD Mission Area: #521 - Electronic & Physical Science (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This 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 operations and crew workload at night, in adverse weather, and at low-level/nap-of-the-earth (NOE) altitudes.

G. (U) RELATED ACTIVITIES: Through an Air Force program (Program Element 6.22.04.F, Project 6095, Inertial Reference and Guidance) and through coordination with the National Aeronautics and Space Administration, the Federal Aviation Administration, working groups, and joint developments' an advantage is gained for all participants for the application of techniques which evolve and to avoid redundant development efforts. Resources are concentrated on problems which are Army unique or not addressed by other development activities. This program element leads to developments in Army Program Elements 6.32.07.A (Aircraft Avionics Equipment) and 6.42.01.A (Aircraft Avionics).

H. (U) WORK PERFORMED BY: US Army Avionics Research and Development Activity, Fort Monmouth, NJ. Contractors include: American Electronic Laboratory, Wall, NJ, and Colmar, PA; Raycomm, Freehold, NJ; Litton Systems, Inc., Van Nuys, CA; Bendix Comm Division, Towson, MD; Airborne Instrument Laboratory, Farmingdale, NJ; Sperry Rand, New York, NY, and Phoenix, AZ; Ohio University, Athens, OH; ITT Research Institute, Chicago, IL; Fairchild Camera and Inst Co., Syosset, NY; United Technology Research Center, E. Hartford, CT; Analytical Sciences Corp., Reading, MA; MIT, Cambridge, MA; GS, Binghamton, NY; and Hughes Aircraft, Culver City, CA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Completed conceptual system design and integrated Digital Modular Avionics Program (DIMAP) bench facility with Technical Avionics System Simulator (TASS) using MIL-STD-1553A data bus. Initiated three-year program for Army Digital Avionics System (ADAS); initiated program for a digital Electronic Master Monitor Advisory Display System (EMMADS), and continued development of night navigation pilotage system. Initiated Avionics System Architecture (AVSAR) effort using the AH-1S COBRA as a baseline and successfully bench/flight tested hover sensor applique. Fabricated and successfully bench tested breadboard components of electronic counter-countermeasures (ECCM) adaptive antenna applique to the AN/ARC-114 radio. Developed short pulse transmitter for multifunction Laser Obstacle/Terrain Avoidance Warning System (LOTAWS) scanning laser system for resolution of wires close to background. Designed, fabricated, and programmed Microprocessor Interface Unit (MIU) and initiated development of Lightweight Multifunction Tactical Beacon System (LMTBS). Established feasibility of Wire Obstacle Warning System (WOWS) Concept, using charged coupled devices. Defined approaches to improve

Program Element: #6.22.02.A Title: Aircraft Avionics Technology
DOD Mission Area: #521 - Electronic & Physical Science (ED) Budget Activity: #1 - Technology Base

Doppler low-speed accuracy and obtain helicopter-adapted precise attitude/heading reference systems (AHRS). Designed and installed a facility to hybrid Doppler with Global Positioning System (GPS), Joint Tactical Information Distribution System (JTIDS) and attitude heading reference systems. Increased dynamic accuracy of the standard ASN-43 Heading Reference by applying a specially programmed microprocessor. Designed and initiated a flight test program to evaluate state-of-the-art attitude and heading reference systems. Successfully completed tests of manpack size Ku-band precision landing system. Completed simulation investigations of candidate advanced landing system displays for helicopter decelerated steep instrument approach in coordination with National Aeronautics and Space Administration (NASA). Initiated a joint project with NASA Ames for analysis of criteria for helicopter decelerating steep instrument approach and landing. Initiated a Self-Contained Landing System project through a contract with Ohio University. Demonstrated concept of Very Lightweight Air Traffic Management Equipment (VLATME) using miniaturized L-Band interrogators for Air Traffic Control. Conducted the Beacon Collision Avoidance System (BCAS) experiment which demonstrated the feasibility of tracking friendly aircraft utilizing transponder signals resulting from secondary radars outside the VLATME system. Evaluated Beacon Collision Avoidance System (BCAS) for possible application to tactical air traffic control. Initiated multifunction CO_2 Nap-of-the-Earth (NOE) sensor effort for feasibility testing of simultaneous capability for wire detection, terrain following, doppler navigation and hover, and an experimental assessment of tactical target discrimination techniques.

2. (U) FY 1980 Program: The development of the digital avionics hardware for the digitally integrated research aircraft will continue with emphasis on adaptation of system architecture and human factors from current to future aircraft systems and initiating fabrication of multiplex and integrated control/display hardware. A contractual effort to implement the digital map generator component of the phase 3 developmental configuration of the Night Navigation/Pilotage System (NNPS) will be initiated. Simulation and flight evaluation of phase 1 NNPS development (land symbology mode) and phase 2 NNPS developmental hardware (complete pilotage symbology and digitally generated topographic map) is planned. Continue work on Single Channel Ground and Airborne Radio System (SINCGARS) V antenna. Investigate long-range airborne communication needs. Explore target discrimination techniques for CO_2 sensors under Multifunction CO_2 Nap-of-the-Earth (NOE) Sensor Program. Evaluate candidate system for wire and wire-like object detection. Complete delivery of a flyable demonstration model of Electronic Master Monitor Advisory Display System (EMMADS). Assess prototype advanced attitude/heading references for helicopters. Initiate study of ring laser gyro for use in Army Aircraft - Attitude/Heading Reference System (AHRS). Initiate strap-down magnetic compass feasibility study to upgrade helicopter heading accuracy. Reduce Doppler Velocity Bias to increase low-speed velocity accuracy for NOE navigation. Initiate Position Location Reporting System (PLRS)-Doppler Hybrid Navigation to increase battlefield position accuracy. Initiate van tests of the Global Positioning System (GPS)-Doppler Hybrid assembled in-house. Continue low-visibility breakout work for helicopters. Determine helicopter terminal area system and assess potential of various sensor techniques for application to self-contained landing. Complete improvements in the Very Light Weight Air Traffic

Program Element: #6.22.02.A Title: Aircraft Avionics Technology
DOD Mission Area: #521 - Electronic & Physical Science (ED) Budget Activity: #1 - Technology Base

Management Equipment (VLATME) and Electronically Scanned Antenna (ESCAN) concept hardware and evaluate performance. Assess results of Multi-Modal concept study and assess compatibility with basic VLATME. Initiate a new program to indentify the effects of composites on aviation electronics.

3. (U) FY 1981 Planned Program: The Army digital avionics system hardware will be completed and delivered to a hot bench-based digital system integration facility. A sensor/controller simulator will also be integrated into the hot bench. A data base simulation computer program will be developed to provide a capability to simulate multiplex data base operation. Software program will be converted from phase 2 of Night Navigation Pilotage Program to the phase 3 configuration. This results in the integration of the following night navigation pilotage functions: terrain correlation navigation update, high-speed digitally generated topographic map, and pilot and copilot symbology. Complete design and test of Single Channel and Airborne Radio System (SINCGARS) V Antenna. Procure exploratory hardware for advanced audio systems. Flight test Multifunction CO_2 Nap-of-the-Earth (NOE) Sensor system and initiate user/developer letter of agreement. Advanced display techniques efforts will continue with emphasis on solid-state display modules employing thin-film transistor on silicon circuitry and a solid-state display medium. Conclude Attitude Heading Reference System (AHRS) performance feasibility tests and assessment. Determine application of the ring laser gyro to heading reference systems to increase reliability in the NOE environment. Continue the contract developments of the strap-down magnetic compass and of the low-speed doppler velocity begun in FY80. Install and van-test the Position Location Reporting System (PLRS)-Doppler Hybrid navigation experimental configuration started in FY80. Develop a Kalman filter for the Global Positioning System (GPS)-Doppler position update system assembled in FY80 to improve battlefield Positioning and Navigation performance. Continue Navigation system analysis defined in FY80 via computer modeling. Test the incorporation of low air-speed in the lightweight doppler navigation system. Continue Doppler Position Location Reporting System (PLRS) hybrid. A prototype of a position/navigation system for Advanced Airborne Signal/Intelligence Electronic Warfare (EW) system will be configured and flight tested. Complete testing and prepare a report of the Joint Tactical Information Distribution System (JTIDS) Doppler Hybrid Navigation experimental configuration. Continue attitude heading reference system efforts aimed at a solid-state system for increased ruggedness and realiability. Low visibility breakout flight tests in real instrument flight rules (IFR) conditions will be conducted to form the basis for implementation of IFR decelerating steep approach and landing techniques. Award a contract for air traffic control controller/pilot equipment, which will result in greater continuity of feedback between simulation experiments and actual flight research. Award a contract for self-contained landing system design plans. Initiate development of detailed system concept for feasibility prototype Multi-Modal Very Light Weight Air Traffic Management Equipment (VLATME)/Beacon Collision Aviodance System (BCAS).

Program Element: #6.22.02.A Title: Aircraft Avionics Technology
DOD Mission Area: #521 - Electronic & Physical Science (ED) Budget Activity: #1 - Technology Base

4. (U) FY 1982 Planned Program: The Army digital avionics system hardware will be integrated into the digital hot bench. A complete electronic system specification for future aircraft procurement will be prepared. Design and fabrication of the phase 4 Night Navigation/Pilotage System will be undertaken. Continue advanced communication system analysis and investigate antenna techniques for electronic counter-countermeasures for all aircraft communication bands. Continue hybrid multispectral airborne sensor with increased immunity to weather. Initiate program for development of the Integrated Mission Management System (IMMS). Start new investigations into improvements in aircraft display systems and display media. Synthesize navigation subsystem architecture to reduce size/cost and improve Nap-of-the-Earth (NOE) accuracy/reliability based on FY81 navigation systems modeling. Incorporate strap-down magnetic compass into a heading reference to measure heading accuracy improvement. Assemble a ring laser gyro based on FY81 navigation systems modeling. Test the Doppler Velocity bias reduction low-speed performance. Start developing Doppler navigation altimetry technique to save aircraft space, weight, and power and achieve three-dimensional Nap-of-the-Earth (NOE) navigation. Develop a breadboard Position Location Reporting System (PLRS)-Doppler integrated Control Display Unit (CDU) based on FY81 van test. Apply the Kalman filter to the Global Positioning System (GPS)-Doppler in-house assembly and van test. Complete flight testing of low-visibility breakout hardware, which will form the basis for operational implementation of instrument flight rules (IFR), decelerating steep approach and landing techniques. Complete development of systems concept and initiate development of the Multi-Modal Very Lightweight Air Traffic Management Equipment (VLATME)/Beacon Collision Avoidance System (BCAS) feasibility model. Also initiate development of VLATME/Integrated Communications, Navigation and Identification-Time Division Multiple Access (ICNI-TDMA) interface hardware. Continue investigation into the unique avionics problems due to the use of composites in aircraft.

5. (U)) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.22.09.A
Title: Aeronautical Technology
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	16818	17128	21648	24028	Continuing	Not Applicable
AH76-A	Aerodynamics	2277	2225	2300	2715	Continuing	Not Applicable
AH76-B	Structures	2745	2575	2925	3460	Continuing	Not Applicable
AH76-C	Propulsion	3560	2670	3687	3880	Continuing	Not Applicable
AH76-D	Reliability & Maintainability	1445	1473	2050	2100	Continuing	Not Applicable
AH76-E	Safety & Survivability	2362	2470	3110	3200	Continuing	Not Applicable
AH76-F	Mission Support	805	870	1155	1350	Continuing	Not Applicable
AH76-G	Aircraft Systems Synthesis	1726	2030	1706	1826	Continuing	Not Applicable
AH76-H	Aircraft Subsystems	820	390	1045	1525	Continuing	Not Applicable
AH76-K	R&D Flight Simulation	386	800	840	797	Continuing	Not Applicable
AH76-J	Helicopter Analysis	284	1125	1450	1650	Continuing	Not Applicable
AH76-M	Man-Machine Integration	408	500	580	720	Continuing	Not Applicable
AH76-N	Research Aircraft Systems	0	0	800	805	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program conducts exploratory development to expand scientific knowledge in the field of aeronautical technology. This is essential to permit Army aviation to gain and maintain a technology advantage to sustain the operational effectiveness and mission capability of future Army aviation systems integral to the conduct of land battle. Technical areas are as indicated above.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: The FY 1981 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, influence of ground effects, dynamics of advanced rotors, vibration reduction, stability, control, handling qualities, design criteria, advanced structural materials (composites) for rotors and airframes, and small gas turbine engine components. Additional areas of effort include development of diagnostic

Program Element: #6.22.09.A Title: Aeronautical Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

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; development of helicopter ground movement system; development of R&D simulators with analytical/analysis capability; and reduced pilot workload through research in man-machine integration.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	16818	17128	21648	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	15659	17183	19932	Continuing	Not Applicable

Current submission for FY 1981 ($21,648) represents an increase of $1716. This change reflects inflation adjustments and a decision to maintain a modest growth for the aeronautical technology base. The decrease in FY80 ($17,128 vs $17,183) reflects a general Congressional fund reduction. The increase in FY79 ($16818 vs $15659) reflects additional emphasis in propulsion, reliability and maintainability, and safety and survivability technology base.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.22.09.A
Title: Aeronautical Technology
DOD Mission Area: #521 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The purpose of this program is to provide a sound technological base for advanced and engineering development programs by providing the essential aeronautical technologies required for improvements in the operational effectiveness and mission capability of Army aviation systems. This is necessary so that a technology advantage can be maintained for the US Army. 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 thermodynamics 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 equipment, secondary power systems, environmental control systems, flight simulation, and aviation human engineering. The overall objective is to develop these technologies for application 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 product improvement programs of other aviation systems.

G. (U) RELATED ACTIVITIES: Related programs are performed by the National Aeronautics and Space Administration (Low Speed Aircraft Research and Technology - 505-42-XX), (6.22.4N - Aircraft Technology Navy, Air Force, 6.22.01F - Flight Dynamics) and Department of Transportation. Coordination to eliminate unnecessary duplication is accomplished by: joint program review, 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; 6.32.11.A, Aircraft Electronic Warfare Self-Protection Equipment; 6.32.09.A, Air Mobility Support; and 6.32.11.A, Rotary Wing Controls, Rotors, Structures.

H. (U) 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. For FY81, fifty-six percent, or approximately fourteen million dollars, of the budget for this program is contracted. The principal 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; Detroit Diesel Allison, Indianapolis, IN; Hughes Helicopter, Culver City, CA. At least twelve other contractors will share in this program. Many contracts are still open to be awarded on a competitive basis.

Program Element: #6.22.09.A Title: Aeronautical Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

1. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: A helicopter hub/pylon drag analysis and testing program continues. Full-scale flight tests of an AH-1G composite rotor with advanced designed tips continues including a high-altitude performance evaluation. Wind tunnel full-scale tests of a Sikorsky S-76 research rotor and a full-scale multicyclic controllable twist rotor were completed. Work continued for a generic helicopter simulation. Simulation experiments for terrain flying were conducted. Visual, motion, and simulation systems requirements for the Aviation Research and Development Command R&D simulator were specified. 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 tested. These clutch designs provide 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. An oil debris analysis program was improved. Technology for reducing radar signature of helicopter rotor blades was developed. The Autorotation Analysis Program has been completed. Tests of the vee-tail were completed and indicated a need for greater tail volume. Tests on the circulation control tailboom indicated only 2/3 of the predicted capability. The ability to accurately reproduce in-flight noise patterns in the Vertical/Short Take-Off and Landing (V/STOL) tunnel was verified. Damage levels and blade life after ballistic damage have been accurately predicted and will be used to develop a damage guideline. An oil-filtering system has demonstrated its ability to significantly reduce bearing and gear wear and extend component life.

2. (U) FY 1980 Program: Programs to validate the lifting surface theory hover analysis, to improve loads analysis, and to improve rotorcraft wake analysis will be continued. A study to identify methods and devices for improving autorotation and maneuver capability will also continue. The hub/pylon drag tests completed in 1979 will be analyzed in house. Wind tunnel studies of main rotor/tail rotor flow interactions, rotor/fuselage/empennage optimization, and engine exhaust gas reingestion will be continued. Design of the Research and Development (R&D) simulator visual system and motion system will continue following simulation system studies. Procurement package for selection of software for a second-generation comprehensive helicopter analysis system (TA-J) will be completed. Fabrication and mechanical integrity testing of two cooled, radial-flow turbine designs and the design, fabrication, and testing of five diffuser designs for a 10:1 pressure ratio will be extended. External cargo operation technology will continue with initiation of wind tunnel tests of candidate systems. Laboratory and flight testing of promising ice phobic coating materials for main rotor blades will continue. Fabrication of dynamic test hardware for the microwave deicing concept will continue. Man-machine integration efforts will be continued in the areas of

aircrew workload, flight simulation, information transfer, and man-machine dynamics. Programs to investigate active rotor loads control and composite fuselage fabrication will also be continued. Rotor dynamic testing, vibration reduction, rotor mast/hub restraint design criteria, aero-elastically conformable rotor systems study and structural integrity modernization will continue.

3. (U) FY 1981 Planned Program: Investigation of main rotor/tail rotor/fuselage interaction will continue to include investigation of exhaust gas re-ingestion. A full-scale demonstration of an improved hub and pylon configurations will also continue. Results of wind tunnel tests of advanced helicopter components will be published. Advanced turbine cooling techniques will be initiated using the T-700 engine under typical operating conditions. Composite structure repair methods will be developed and refined. Fabrication of ballistic-damage-tolerant flight control system will be initiated. Technical demonstration for loading/restraint and gondola systems will be conducted and the auto loading and static electricity discharge systems will continue. The hydraulic system improvement program will be completed and the electrical system upgrade program will continue. The executive system for the Second Generation Compressive Helicopter Analysis System (2GCHAS) will be developed and released for verification. Modification of the Verticle Motion Simulator (VMS) cab and fixed-base station will continue. Flightworthy tactical display concepts will be integrated to permit simulator evaluations of aircraft operating in tactical situations. Personnel involved for this program element include 177 professionals and 147 support personnel.

4. (U) FY 1982 Planned Program: Specific efforts planned include: Advanced rotor/airfoil combinations will continue to be developed and refined. Advanced propulsion system components will be developed for fuel-efficient concepts. Advanced hybrid composite structure subsystems will be developed for minimum cost and weight designs. Highly maintainable/repairable concepts will be emphasized. Systems which survive sophisticated enemy threats will be explored and developed. Ground support system for enhancing forward area mobility will be emphasized. Continued refinements in methods for comprehensive helicopter analysis will be pursued. Emphasis on man-machine integration problems will continue to develop workload measurements and methods for laboratory and engineering use.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.22.10.A
DOD Mission Area: #523 - Engineering Technology (ED)

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

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	950	1327	1882	2001	Continuing	Not Applicable
D283	Airdrop Technology	950	1327	1882	2001	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports basic airdrop technology for all the Services, evaluates the feasibility and practicability of new concepts which have potential for increasing and/or enhancing the probability of successful execution 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 includes parachute technology, is essential for the employment and resupply of airborne and conventional units. Airdrop projects are included in the US Army Training and Doctrine Command (TRADOC) critical category priority list, the Science and Technology Guide (STOG), and Capabilities Categories (CAPCAT) 80-5.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Continue exploratory development efforts in the areas of Gliding Decelerator Technology, Rigging Technology, High-Level Airdrop Technology, Airdrop Simulation, High-Speed Airdrop Technology, Advanced Airdrop Technology, and Design Criteria for Airdrop Aircraft. Initiate work in Free-Drop Technology, Parachute Technology, Airdrop on Water Zone Concepts, Developmental AF Aircraft Airdrop Engineering Support, and Soft Landing Concepts.

Program Element: # 6.22.10.A
DOD Mission Area: #523 - Engineering Technology (ED)

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

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	950	1327	1882	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	1208	1327	1599	Continuing	Not Applicable

The decrease in the FY 1979 estimate reflects a reprogramming decision by the developer to cover higher priority needs. The increase in FY 1981 is to cover several new technical efforts in response to the Science and Technology Objectives Guide requirements and the increasing importance of airdrop to direct combat support.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 6.22.10.A
DOD Mission Area: #523 - Engineering Technology (ED)

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

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Major areas of effort are: the validation of computer modeling of high glide decelerators, defining and testing feasible airdrop guidance and control systems, exploring airdrop feasibility at higher aircraft drop speeds and airdrop altitudes, developing design criteria for airdrop aircraft, developing new rigging concepts for cargo loads, development of airdrop computer and physical simulations, and continuation of the development of advanced airdrop technology. Objectives are to increase airdrop operational capabilities at all altitudes and in all weather and geographical environments, increase airdrop accuracy, reduce drop zone dispersion, provide the technology base for advanced airdrop systems, eliminate technical barriers hindering attainment of new airdrop capabilities, and reduce the costs of developing airdrop components and systems.

G. (U) RELATED ACTIVITIES: Program Elements 6.32.18.A, Airdrop Equipment and Techniques, and 6.42.18.A, Airdrop Equipment Development; Joint Technical Coordinating Group/Airdrop; North Atlantic Treaty Organization, and Air Standardization Coordinating Committee (ASCC/WP44) Standardization Agreements; Mutual Weapons Data Exchange Agreements with France and Germany. International and interservice agreements and boards are used to exchange information on gains in airdrop technology, to avoid duplication of effort through joint and combined efforts, and to promote and attain the objectives of US Rationalization, Standardization, and Interoperability (RSI) policies and programs.

H. (U) WORK PERFORMED BY: Arthur D. Little, Inc., Cambridge, MA; Georgia Tech Research Institute, Atlanta, GA; Irvin Industries Ltd., Canada, Canada; Pioneer Parachute Co., Manchester, CT; Bertin & Cie, Plaiser, France; US Army Yuma Proving Ground, AZ; and US Army Natick Research and Development Command (NARADCOM), Natick, MA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Selected canopy design concepts for Free-Fall Maneuverable Reserve Parachute and transitioned to Engineering Development. Began a program definition study to develop techniques, equipment, and facilities for the simulation of the airdrop environment. Identified and conducted test of new materials for three-gallon Free-Drop Water Container. Procured French Balloon Skirt as potential airdrop platform energy dissipater system. Completed contract to identify operationally feasible concepts for airdrop Drop Zone Assembly Aids. Initiated study of air flow behind airdrop aircraft to solve problems of extraction parachute performance. Completed in-house analysis to determine overall impact of airdrop at higher aircraft speeds. Selected and flight tested one prototype to overcome pitch instability of platform loads at high altitudes; under contract, developed a second concept to overcome pitch instability. A computer simulation program for the flight performance of gliding decelerators was developed and studies initiated to validate computer models through flight testing. Contract to assess the state-of-the art hardware available for guidance and control was completed, and evaluation of alternative guidance and control hardware for gliding decelerators initiated. Awarded contract for design and test of gliding decelerator(s). Completed feasibility study of retrorocket soft-landing concept.

Program Element: # 6.22.10.A Title: Airdrop Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

2. (U) FY 1980 Program: Resume studies on soft-landing concepts and complete feasibility test of French balloon skirt as potential "soft landing" alternative. Procure/evaluate selected systems as potential drop zone assembly aids. Continue studies to develop design criteria for airdrop aircraft. Develop knowledge, concepts, and test plans needed to proceed with in-house and contract studies on high-speed airdrop systems. Complete testing of prototype components and solve pitch instability problems of high-level airdrop platform system to include parachute configurations and rigging details. Continue the computer simulation studies of alternative guidance techniques and procure selected prototype guidance hardware systems and initiate testing. Continue in-house flight performance testing of gliding decelerators; complete design of the medium-load capacity gliding decelerator. Continue to develop new rigging concepts with emphasis on roll-on/roll-off capability and reduced time to rig/derig vehicles. Obtain quantitative force-time data from actual personnel drops. From plans developed in 1979, initiate development of laboratory simulation techniques and equipment for airdrop parameters.

3. (U) FY 1981 Planned Program: Continue exploration of new airdrop concepts and the development of advanced airdrop technology. Provide airdrop engineering and technical support in the development of AF airdrop aircraft. Continue development of design criteria for airdrop aircraft. Award contract to analyze problems associated with high-speed airdrop including airdrop aircraft considerations. Initiate studies of high-level airdrop of personnel to identify problem and alternative solutions. Optimize high-level airdrop platform system design; complete feasibility tests and transition to advanced exploratory development. Continue tests of selected guidance and control hardware, modify as required, and initiate feasibility test of gliding decelerator(s) with selected guidance/control system(s). Procure prototype of selected alternative soft-landing concepts. Prepare rigging design concepts which will provide roll-on/roll-off capability. Continue developing information and data to provide a laboratory airdrop test simulation capability. Resume efforts to develop data base for design of free-drop resupply airdrop system and initiate design of suitable airdrop configurations. Update the technology base on the performance, stability/control, and structural design of cargo and personnel parachutes. Initiate studies to develop feasible concepts for airdrop on water drop zones. Eleven professional and eight support personnel are involved in the program.

4. (U) FY 1982 Planned Program: Continue exploration of new airdrop concepts and the development of advanced airdrop technology. Study and select new airdrop equipment designs for application to new and enhanced Air Force aircraft. Conduct wind tunnel tests to determine aircraft design parameters which impact on airdrop systems performance. Investigate application of gliding parachute technology to airdrop high-speed systems. Continue efforts to develop high-level airdrop technology. Investigate prototype hardware to permit airdrop at higher aircraft drop speeds. Complete flight tests of 150 kg capacity gliding decelerator cargo system and initiate flight tests of 4000 kg capacity system. Complete fabrication and initiate testing of a soft landing airdrop system. Investigate shrink wrap and vacuum rigging concepts to simplify rigging of cargo loads for airdrop. Refine concepts for jumping with personal equipment and weapons. Conduct airdrop flight tests to obtain data for use in developing laboratory simulations. Continue fragility testing of common airdrop resupply items and initiate

Program Element: # 6.22.10.A
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packaging designs for free drop. Continue theoretical work in parachute technology and initiate supporting experimental tests. Continue to define airdrop systems useable with water drop zones.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.23.03.A
Title: Missile Technology
DOD Mission Area: #523 - Engineering Technology
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	28299	27807	30368	34604	Continuing	Not Applicable
A214-01	Sensors Technology	4579	4458	4988	5607	Continuing	Not Applicable
A214-02	Guidance and Control Technology	3812	3300	3900	4150	Continuing	Not Applicable
A214-03	Terminal Guidance Technology	3368	2884	4050	4550	Continuing	Not Applicable
A214-04	Digital Technology	725	1500	1750	2210	Continuing	Not Applicable
A214-05	Simulation Research Technology	2643	2588	2850	3200	Continuing	Not Applicable
A214-06	Experimental Systems Technology	2384	3622	2900	3300	Continuing	Not Applicable
A214-07	Aerodynamics Technology	2840	2550	2550	2800	Continuing	Not Applicable
A214-08	Propulsion Technology	3662	3025	3050	3400	Continuing	Not Applicable
A214-09	Ground Support Equipment Technology	1436	1460	1550	1900	Continuing	Not Applicable
A214-10	Structures Technology	944	950	1050	1440	Continuing	Not Applicable
A214-11	Technology Integration	446	575	800	900	Continuing	Not Applicable
A214-12	Systems Concepts and Analysis Technology	330	495	450	600	Continuing	Not Applicable
A214-13	Sensors and Control Technology for Guided Projectiles	400	400	480	547	Continuing	Not Applicable

Program Element: #6.23.03.A Title: Missile Technology

DOD Mission Area: #523 - Engineering Technology Budget Activity: #1 - Technology Base

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Estimated Costs
A214-14	Hybrid Microelectronics Technology	430	0	0	0	Continuing	Not Applicable
A214-15	High Energy Laser Research Technology	300	0	0	0	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program includes virtually all of the exploratory development work conducted by the US Army Missile Command to provide the technical base for future Army tactical missile systems and evolutionary or modular improvements to fielded systems. It is responsive to the operational needs identified on an annual basis by the user proponent in the form of science and technology objectives, and encompasses work in applied research, laboratory hardware development, and limited experimental testing. The principal thrusts are in the areas of Air Defense, Fire Support and Close Combat. The Close Combat area addresses both antitank and assault/military operations in urban terrain (MOUT) requirements. This program helps protect the US technological lead in tactical missiles and rockets and satisfies a critical Army requirement to: (1) maintain a strong in-house technical arm that can be a smart buyer and work in a cooperative way with industry, the military user, and the academic community to provide the best missile/rocket hardware and technology at least practical cost; (2) provide for research and development in those areas where there is little or no incentive for industry because of the lack of a major commercial market; (3) provide for technical options and viable alternatives that preclude unwarranted sole source procurements; and (4) provide a quick response capability in time of crisis.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Request for continuation of exploratory development work in missiles and rockets to enhance Army capabilities in Air Defense, Fire Support, and Close Combat. Major efforts include: complete the design of a track-while-scan quiet radar; establish technology base for a lightweight air defense suppression missile; development on a fiber-optics guided missile concept; complete exploratory development on a kinetic energy penetrator antiarmor concept; transfer to advanced development a rifleman's assault weapon concept and a special hard target assault weapon concept; continue exploitation of promising rocket motor concepts and techniques for reducing propellant signature and rocket motor costs; emphasize the development of various seekers/sensors covering the acoustical, radio frequency, millimeter wave, and infrared, that provide improved capability in adverse environments; continue the development of electro-optical sensors; advance methods for improved structural analysis and develop design techniques for composite structures; improved aerodynamic analysis and design; develop launching techniques for firing from enclosures; develop under armor tracking mounts for increased accuracy and range; develop automatic test equipment for missile systems; flight test the fiber optics guidance demonstration (FOG-D) test vehicle; analyze previous simplified inertial guidance demonstration (SIG-D) flights; integrate self-forging fragment warhead/sensors technology into existing missile system hardware (TOW); formulate a comprehensive air defense evolution and product improvement options plan; and continue smoke/aerosol phenomenological work.

Program Element: #6.23.03.A
DOD Mission Area: #523 - Engineering Technology

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

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	28299	27807	30368	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	28726	29350	32823	Continuing	Not Applicable

There are differences in the projected funding for both FY80 and FY81 between the FY 1980 RDTE Congressional Descriptive Summary (CDS) and the FY 1981 RDTE CDS. The change in the FY 1980 funding is due to a Congressionally directed decrease of $1.5 million which had been requested for the development of technology which could lead to a lightweight air defense suppression missile (ADSM). Minor funding adjustments have been made among the projects as this last year's developments were evaluated and priorities for the years FY 1980 and FY 1981 were fine-tuned. The reduction of $2455 for projected FY 1981 funding in this program element was due to redistribution to higher priority projects. The Hybrid Microelectronics Technology project area was not funded for FY 1980 and FY 1981 because it was considered to be of lesser priority and the funds available were not enough to significantly affect the advance of this technology.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.23.03.A
DOD Mission Area: #523 - Engineering Technology

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

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The broad objectives of the program are to: (1) develop guidance and control and terminal homing systems having multimode and fire-and-forget characteristics, reduced vulnerability to antiradiation missiles, and the capability for operation in adverse weather and countermeasures environments; (2) develop minimum signature propulsion systems and low-cost missile/rocket components with improved service life; (3) reduce development cost through simulation/tactical software; (4) reduce risk in new system developments. These objectives involve most of the scientific and engineering disciplines related to missile and rocket development. The program consists of 15 technology areas (corresponding to the project numbers listed in paragraph A), 13 of which are currently active. Work areas contained within the technology areas follow: Sensors - advanced radar; acoustic/infrared sensing and signal processing; optical command and beamrider; millimeter guidance; infrared homing; radio frequency (RF) guidance; sensor design and signal processing. Guidance and Control - advanced guidance systems; modular guidance; automatic tracking and integrated fire control; inertial components; laser designator/weapon systems simulation; advanced analysis for future missile guidance and control. Terminal Guidance - guidance system integration and verification; optical homing; system application of sensors; laser guidance and designators; terminal homing measurements. Digital - missile tactical software; missile imbedded computer hardware. Simulation Research - RF simulation technology; infrared/electro-optical simulation technology; hybrid computer technology; millimeter simulation. Experimental Systems - Air Defense weapons, infantry weapons, small craft weaponization; aircraft weapons; artillery systems. Aerodynamics - Flow interference phenomena affecting tactical missiles; advanced missile interceptor aerodynamics; submissile aeroballistics; verification of hypervelocity antiarmor concepts; dynamically aimed free flight rocket concept; elastic airframe effects on missile performance; low-cost multiple rocket system aerodynamics. Propulsion - low exhaust signature propulsion; cost reduction; advanced concepts (for example, exploit laser-induced chemistry to overcome a propellant burning rate barrier for more effective future close support weapons and reduce impulse noise for advanced shoulder-fired weapons). Ground Support Equipment - launching techniques; airborne support equipment technology; launcher control systems; auxiliary systems technology (including automatic test equipment). Structures - missile system structures; structures analysis; environmental effects (including advanced ablative radomes). Technology Integation - technology planning, independent research and development. Systems Concepts and Analysis - user requirements analysis; new concept generation. Sensors and Control for Guided Projectiles - indirect fire; direct fire.

G. (U) RELATED ACTIVITIES: Efforts in this program relate closely to science and technology programs conducted by the Defense Advanced Research Projects Agency (DARPA) (PE #6.27.11.E), the US Navy (PE #6.23.32.N), the US Air Force (PE #6.26.02F and 6.36.01.F) as well as to other programs within the Army (PE #6.33.06.A). Unwarranted duplication is precluded by active participation by laboratory personnel in interagency working groups, liaison visits to agencies/activities involved in missile-related science and technology work, the free exchange of information among agencies via the Defense Technical Information Center and the National Technical Information Service, and deliberate structuring of the program to concentrate on the Army's unique needs in tactical missiles. Where areas of potential unwarranted duplication have been identified,

appropriate agreements have been effected with the command/agency concerned. Membership exists in working groups of the Joint Services Guidance and Control Committee (JSGCC), The Joint (tri-Service) Technical Coordinating Group for Munitions Development (missiles and rockets), Joint Army/Navy/National Aeronautics and Space Administration (NASA)/Air Force committees, and North Atlantic Treaty Organization Panels. Under the JSGCC, for example, a tri-Service working group on terminally guided submunitions has been active for two years, and three new working groups covering millimeter wave guidance, active/passive radio frequency guidance, and midcourse guidance have been recently formed. These initiatives have proved effective in eliminating unwarranted duplication. Reorganization of the US Army Missile Command and the inclusion of the DARPA Projects office at Redstone Arsenal within the control of the Director of the Army Missile Laboratory will increase technology dissemination between DARPA and the Army. High Energy Laser Research Technology efforts which were formerly done under this Program Element (6.23.03.A, A214-15) are now being conducted under the separate Program Element 6.23.07.A.

H. (U) WORK PERFORMED BY: The US Army Missile Command (MICOM), Redstone Arsenal, AL, has primary responsibility for execution of this program. Approximately 48 percent of the dollars are contracted out to more than 50 contractors and universities. Major contractors include Hughes Aircraft Corporation, Fullerton, CA; Battelle Memorial Institute Columbus, OH; Texas Instruments Incorporated, Dallas, TX; and Martin-Marietta, Orlando, FL. Universities include Georgia Institute of Technology, Atlanta, GA; Auburn University, Auburn, AL; University of Alabama, Huntsville, AL; University of Alabama, Tuscaloosa, AL; Tennessee Technological University, Cookeville, TN.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A breakdown of key accomplishments in each of the technology areas follows: Sensors - Explored and developed through breadboard/brassboard/testbed the following seeker/sensors: common aperture multisprectrum seeker for possible application to an air defense suppression missile; multi-environment active radio frequency seeker for possible application to a variety of antiarmor systems such as the HELLFIRE helicopter-borne missile system, the COPPERHEAD artillery projectile, and emerging advanced antitank missile systems concepts for adverse weather capability. Infrared imaging seeker for possible HELLFIRE application was evaluated in captive tests and evaluated in Smoke Week tests. Fabrication of a breadboard millimeter differential guidance was started. Two-color infrared (IR) seeker for indirect fire, which is a candidate in the Assault Breaker demonstration for defeat of second-echelon armor, was developed. An advanced signal processer was developed for the POST ROSETTE seeker prior to transition into engineering development in the STINGER air defense missile system program. Breadboard of optical-magnetic sensor was fabricated for testing. Developed radio frequency active seeker for possible application to small-diameter (five- to eight-inch) air defense missiles and continued accelerated development of integrated focal plane array seekers for application to next-generation systems employing imaging seekers. Completed the design & fabrication for a low sidelobe, agile beam antenna aimed at reducing the vulnerability of air defense

Program Element: #6.23.03.A
DOD Mission Area: #523 - Engineering Technology

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

systems to the antiradiation missile threat and demonstrated low-angle tracking of helico ters. Designed a signal analysis van for support of reduced signature radar field tests; demonstrated adaptive gate centroid/correlation imaging tracker concept using high-speed microprocessor technology; demonstrated a forward looking infrared (FLIR) video track link; hardware for CO_2 laser beamrider tests was fabricated; CO_2 Laser Beamrider data links were evaluated in US and foreign smokes and dust testing. Guidance and Control - Conducted laboratory evaluation and missile flight test of a microprocessor autopilot in a small high-performance missile. Time optimal dive control was simulated for both experimental six-inch (T6) and HELLFIRE missiles; this algorithm provides'
Developed waveguides and directional couplers for micro-optic gyro application to missile guidance; this application results in a low-cost, high-rate, solid state gyro. Defined program of measurements and simulation development for determination of battlefield environment laser designator weapons system simulation (LDWSS). Completed all Simplified Inertial Guidance Demonstration (SIG-D) verification testing; one missile flight was successfully conducted. Terminal Guidance - Explored terminal homing applications of solid state imaging devices in an effort toward achieving an automatic target acquisition capability for possible missile guidance and advanced helicopter applications; completed a generic infrared (IR) weapon system simulation for imaging and nonimaging IR seekers. A microprocessor was integrated with a laser seeker to demonstrate that microprocessor-control of the seeker head and signal processing functions can be accomplished; captive tests of a breadboard 2.75-inch dual-mode RF infrared seeker were started. Experimental development of dual-mode RF/infrared imaging seeker was initiated; one-way transmission for long-range indirect fire missile guidance concept was demonstrated; comparative field measurements at were completed to evaluate polarization and frequency agility techniques for target discrimination in clutter backgrounds; infrared target-background imagery data at, was analyzed. Digital - designed missile system compiler using low-cost code generator methodology which results in lower cost compiler code generators; performed initial selection and development of automated software design methodologies and tools, demonstrated automated digital filter analysis software tool which will reduce cost and improve reliability of software design; developed distributed-microprocessor communication-buss structure for small Army missiles which is compatible with Air Force digital integrating subsystem concept planned for use in all future missile guidance systems; a low-cost microprocessor-based missile computer was designed and fabricated using a single-chip 16-bit microprocessor which will provide 4-inch-diameter and smaller missiles with low-cost processing capability. Simulation Research - The first phase of a computer-based digital data retrieval/storage system was procured. This system permits transfer of very large quantities of simulation data from the host computer in real time without imposing any load on the host. Research was initiated, in partnership with the Air Force, on a thermal transducer for projection of infrared scenes. The interim distributed radio frequency source generator was installed and used in the simulation of fifteen systems. A hierarchy of RF environmental models was established to guide future developments. Experimental Systems - A report "Soviet Threat to US Second Echelon Engagement System" was published. An effectiveness analysis was conducted to determine sensitivity of Corps Support Weapon System (CSWS) to delivery accuracy. Simulation of STINGER in aircraft environment developed and preliminary results obtained; continued development of the Hemispheric Coverage Antenna (HCA).

Program Element: #6.23.03.A
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Title: Missile Technology
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Aerodynamics - Flight validation of technology advancements for a hypervelocity kinetic energy penetrator rocket concept (SPIKE) was initiated with seven successful firings which supported development and verification of the launcher, spin-up mechanism, motor performance, and structural integrity of the rocket component hardware, and rocket aerodynamics during the boost flight phase. Developed and integrated operational hardware for the Fiber Optics Guidance Demonstration effort. Wind tunnel experiments were completed for a high-response air defense missile concept employing variable geometry configurations. An initial assessment was completed of submissile mutual aerodynamic interference when deployed at subsonic and transonic speeds. Propulsion - Completed exploratory development and handed off to engineering development a minimum smoke motor for the CHAPARRAL air defense missile. Developed an improved minimum signature TOW flight motor and handed off for engineering development evaluation. Established improved service life techniques by verifying thermal loading and by establishing maximum moisture limits during processing and storage. Developed improved (capable of Repeated "Alaskan" cycling) minimum signature propellant; high burn rate propulsion system for the VIPER antitank missile; a reduced smoke motor for the HELLFIRE antiarmor missile; and a hydroxyl terminated polybutadiene (HTPB) propellant for the PERSHING long-range, surface-to-surface missile. Ground Support Equipment - Designed and tested low signature launch technique (liquid discharge) for Military Operations in Urban Terrain (MOUT) applications; completed low-cost container-launcher development and testing; developed analyses of rocket exhaust and rocket bending effects of launch accuracy; investigated controls and drives techniques for dynamically aimed launcher; developed launch tube, fail safe, and fin transfer techniques for shoulder-fired free flight rocket applications; established tracking accuracies and requirements for future missile systems under armor; developed system specification and one concept for automatic test equipment for missile systems support. Structures - Conducted screening tests on candidate materials for reusable composite launcher tubes. Acoustical hologram resolution was improved by coupling between the transducer and the fluid. Sled tests were conducted with and without rain to characterize performance of different microfiber- reinforced Teflon structures containing different fiber-to-matrix ratios for ablative radomes. Technology Integration - Army Technology plan has been prepared for briefing. Independent Research and Development (IR&D) monitored and results factored into technology plan where appropriate. Technical Industrial Liaison office (TILO) and Unsolicited Proposal activities were organized and actively functioning in MICOM Laboratory. Systems Concepts and Analylsis - Correlated the Battlefield Development Plan deficiencies with the Science and Technology Objectives Guide for 1980 (STOG-80) requirements for the Army missile Technology Plan; chaired group study on technology, tactics, doctrine, and concepts employing smoke countermeasures; completed enemy aircraft IR signature reassessment; structured product improvement/evolutionary growth options for current systems in Comprehensive Future Systems Plan candidates; completed a defense acquisition radar (DAR)/IHAWK integration study. Sensors and Control for Guided Projectiles - Completed a high-g materials investigation which was applied in the development of the COPPERHEAD artillery projectile; initiated development of g-hardened sensor components, sensors systems, and nonlnertial roll rate systems for indirect fire applications; initiated studies on high-g thrusters, actuators, and aerodynamic controls associated with direct fire applications.

Program Element: #6.23.03.A Title: Missile Technology
DOD Mission Area: #521 - Engineering Technology Budget Activity: #1 - Technology Base

2. (U) FY 1980 Program: Anticipated accomplishments by technology area follow: Sensors - The evaluation of the low sidelobe antenna will be completed, and the design and fabrication of the track-while-scan radar will be started. Design of a drop test for evaluation of acoustic sensing techniques will be completed. A demonstration of the feasibility of CO_2 beamrider guidance will be initiated. The differential guidance experiment will be completed and static tests of millimeter beamrider guidance performed. The low-cost infrared imaging seeker and advanced tracker will be demonstrated. Dual-mode RF and millimeter seeker lock-on, hand-over, and target tracking will be investigated in field tests. Sensors and signal processing techniques will be developed for antitank and air defense guidance sensors. Guidance and Control - Missile flight tests will be conducted to verify several different designs of digital autopilots in program and direct fire applications to establish their control stability and overall system performance in the harsh missile environment. Investigate the master azimuth reference calibration standard gyro-compass suspension in order to improve its stability and reliability. Develop laser designator weapons system simulation (LDWSS) models of terminal guidance units other than laser for the COPPERHEAD and HELLFIRE and evaluate system performance. Conduct two simplified inertial guidance demonstration (SIG-D) missile flight tests and evaluate system performance. Develop analytical techniques for efficient analysis and synthesis of future guidance and control systems. Optimal dive control software will be evaluated in hardware in the loop (HWIL) simulation to increase target impact angles and greatly enhance the probability of kill of small, high-performance missiles against advanced armor. Theoretical analysis of video image enhancement techniques will be conducted to decrease vulnerability of scout and attack helicopters by allowing longer standoff and thus reducing exposure. Terminal Guidance - Nonimaging infrared and focal plane array seekers will be integrated into the simulation; improvements in Technology Base for CO_2 laser designators will be accomplished; adverse propagation effects in the millimeter and infrared regions will be analyzed and modelled. Long wavelength laser and infrared imagery target measurements and analysis will be performed to improve discrimination. Development of a precision RF tracking platform for instrumentation will be started. Algorithms for autonomous acquisition will be developed. Digital - Complete development of interim Ada translator to facilitate use of Ada as low-cost code generator language; complete design of missile system compiler using low-cost code generator methodology resulting in lower cost compiler code generators; complete selection and continue development of automated software design methodologies and tools to reduce cost and improve reliability of software design; develop a practical methodology for partitioning of distributed microprocessing hardware and software functions to meet much more sophisticated missile system requirements; develop a modular family of microprocessor-based computer designs which are compatible with the distributed processing partitioning methodology and microprocessor intercommunication buss techniques which will meet computational and low-cost requirements of future Army missiles regardless of size, range, and mission. Simulation Research - The second phase of the data retrieval/storage system will be procured. The thermal transducer/projector will be carried into engineering design. The Infrared Simulation System will be provided with a display to verify the functioning of the invisible targets generated in the infrared band. An infinity display will be added to the video trajectory display system to enhance realism. Preliminary design of a millimeter simulation facility will be initiated. Experimental Systems - The STINGER airborne self-defense subsystem effort will be terminated with completion of the integration demonstration of STINGER

on the OH-58 and AH-1S aircraft. The requirements for a Corps Support Weapons System will continue to be investigated. Rifleman's Assault Weapon (RAW) - determine lethality of warhead. Over armor technology synthesis (OATS): design, fabricate, and test selected sensors; design and test self-forging fragment warheads. Conduct trade-off analysis and design technology areas needing advancement to make modular missile feasible; Hemispheric coverage antenna (HCA) - (1) refurbish the feed array for the low sidelobe demonstration, (2) modify the beam steering unit software, (3) measure the feed array patterns and replace the dome and make measurements on the improved sidelobe configuration. Aerodynamics - Technology gained from the initial flight firings of the hypervelocity kinetic energy penetrator rocket concept (SPIKE) will be applied to refine the SPIKE configuration. Additional flight firings will be conducted to confirm predicted boost phase rocket performance. Airframe/control aerodynamic requirements for advanced missile intercepters will be identified and quantified to guide future configuration design trade-offs. Submissile deployment simulation model will be upgraded to allow consideration of mutual aerodynamic interference effects. Propulsion - Demonstrate in static firings a minimum signature propellant with adequate low-temperature storage and operational capability; verify decaborane synthesis potential of laser-induced chemistry and compare production costs to conventional process to identify cost drivers; demonstrate in static firings a 10% performance increase for air defense systems through use of an advanced boost-sustain propulsion system. Ground Support Equipment - Complete system tests of liquid discharge low signature launching technique and evaluate for signature effects. Investigate concepts and techniques to improve laying and aiming capability of existing under armor mounts for missile systems. Complete the definition of future missile system test requirements, define levels of testability for future missiles, develop system specifications for multisystem automatic test equipment (ATE). Structures - Initiate a comparative experimental data base for advanced composites and glass materials. Investigate protective coatings for composite materials. Determine critical flaw parameters for composite materials. Conduct sled tests of candidate materials for single-wall ablative radomes. Technology Integration - Publish the Army Missile Technology Plan and assure technology programs are consistent with planned requirements. Monitor and analyze industrial independent research and development for potential solutions to critical Army needs. Integrate into the Laboratory's programs all appropriate domestic and foreign missile technology. Advanced technology will be planned which will allow modular improvements and evolving systems to counter evolving future threats. Systems Concepts and Analysis - User requirements in the MICOM area of development responsibility will be analyzed and updated in generation and analysis of new missile system concepts; threat documents will be reviewed, and updated information will be extracted for use in scenarios to determine cost effectiveness of present/future missile systems. Sensors and Control for Guided Projectiles - Continue to develop and test g-hardened components and systems for indirect fire application; test a g-hardened control force system for direct fire application; develop an infrared scene synthesis model for direct fire application.

3. FY 1981 Planned Program: Planned accomplishments by technology area follow: Sensors - The track-while-scan quiet radar will be completed. The flight demonstration of CO_2 beamrider guidance will be completed this year. Development of experimental millimeter line-of-sight guidance hardware will be started. Long-wavelength infrared focal plane array seeker

hardware will be evaluated. The advanced signal processor for the indirect fire infrared seekers will be evaluated. The development of radio frequency (RF) adverse weather seeker acquisition hardware will be initiated, and the optimal design of an active RF air defense seeker established. Fabrication of a dual-mode RF and millimeter seeker will be started. Hardware designs of imaging signal processing techniques applicable to automatic target recognition will be evaluated. *Guidance and Control* - The evaluation of time optimal dive trajectory digital autopilot (DAP) control mechanisms will occur in flight testing; this accomplishment will enhance the performance of all fire-and-forget antiarmor weapon systems. Digital control algorithms for multimode seeker flights will be extensively simulated and evaluated for different types of seekers (radio frequency, laser/infrared) and tracking modes. Modern adaptive digital control algorithms will be designed for antiarmor missile applications. A breadboard multiple target automatic handoff correlator will be completed, and lab/flight test program will be completed. Specifications for a multitarget handoff correlator applicable to existing or planned Army helicopters will be completed; this will show the feasibility of rapidly acquiring and destroying multiple targets using fire-and-forget missiles. An investigation will be conducted showing how airborne control hardware requirements can be reduced by combining the functions of automatic handoff, image enhancement, missile management, and others in a single, microprocessor-based unit; this is needed to fit fire control advances to existing helicopter designs. Develop strapdown inertial measuring unit (IMU) utilizing multisensor technology; this technology will result in a navigation IMU for medium- and long-range surface-to-surface missiles and midcourse surface-to-air missiles. Develop frequency shifter and frequency tracking electronics for micro-optic laser gyro application; the achievement of a micro-optic laser gyro will result in a low-cost, medium-performance, high-rate capability gyro for short- and medium-range missiles in extreme environments. Refine, validate, and simplify the involved laser designator weapons systems simulation models; exercising these simulations are the only practical means of analyzing system performance over a wide range of launch conditions since the costs of extensive flight tests are prohibitive. *Terminal Guidance* - The cost of runs in the infrared weapon system simulation will be reduced by reducing computer time. Multiple parallel image trackers will be integrated in the simulation, and a graphic mode will be added as a seeker design aid. The interface between dual-mode seekers and the target acquisitions system will be evaluated in field tests. A receiving station for a long-range indirect fire guidance concept will be experimentally developed. Development of an experimental precision RF airborne tracking platform will be completed, and the instrumentation design including the millimeter seeker and reference tracker will be completed. Development of technology, which could lead to an air defense suppression missile, will be initiated

A total of $1.5 million has been allocated under this technology area for this work which will be directed toward the following: development of small passive superhetrodyne seekers (SPSS), larger diameter seekers (nominally eight inches) with enhanced terminal homing characteristics and a radio frequency target designation system (RFTDS). The SPSS effort will consist of the development of a form, fit, and functional RF/IR seeker for laboratory and captive flight testing. The SPSS seeker will be integrated with the RFTDS for performance evaluation. The larger diameter efforts will be directed toward the exploration of advanced terminal homing modes including imaging infrared

Program Element: #6.23.03.A Title: Missile Technology
DOD Mission Area: #523 - Engineering Technology Budget Activity: #1 - Technology Base

and millimeter wave sensors. Digital - Complete integration of low-cost code generator design into Ada Missile system complier which reduces cost and increases reliability of missile software; development and integration of automated software design methodologies and tools to reduce cost and increase reliability and maintainability of missile software. Perform more sophisticated demonstration of the effectiveness of distributed processor buss concept using all other techniques being developed in digital technology (microprocessor computer family hardware, software, and partitioning methodology) to meet distributed processing requirements. Simulation Research - Implementation techniques for previously developed Radio Frequency environmental models will be refined through analysis and hardware-in-the-loop simulation experience. Detail design of a millimeter simulation facility will be initiated. Experimental Systems - Initiate concept definition effort for the modular missile; integrate self-forging fragment (SFF) warhead sensor and flight test the Over Armor Technology Synthesis (OATS) guidance system on TOW. The fiber optic flight test program will continue into FY81. Aerodynamics - The hypervelocity kinetic energy penetrator rocket concept (SPIKE) flight tests will be completed, data analyzed, and the concept assessed as a potential antiarmor system. Experiments will be initiated to develop a mutual aerodynamic interference model for deployment simulation analysis under the submissile aeroballistics work area. Flight tests will be conducted for the dynamically aimed free flight rocket concept to demonstrate the potential for improving accuracy of unguided rockets. A new work area will begin to investigate elastic airframe effects on missile performance. Propulsion - Complete unguided flight verification tests of an advanced propulsion system; demonstrate, in static firings, noise reduction of an antitank motor by at least 10 db with minimal impact on performance; evaluate high-energy binders synthesized by laser-induced chemistry in minimum signature propellant formulations. Ground Support Equipment - Complete design of liquid discharge rocket for optimum performance and conduct tests to verify low signature launch for requirement regarding Military Operations in Urban Terrain (MOUT); a modified under-armor tracking mount will be tested to ascertain improvement in laying and aiming accuracy, and state-of-the-art advancements in solid state power and switching devices will be incorporated into conceptual designs to improve mount reliability; continue development of automatic test equipment system to fulfill requirement for simplified diagnostics and repair of equipment in the field. Structures - Continue characterization of composite materials of different fiber/resin combinations. Fracture mechanics of composites will be continued and incorporated into design techniques. Investigation of molded plastics to meet electromagnetic impulse (EMI) and structural degradation for low-cost structural components will be initiated. Technology Integration - Technology Base Plan will be updated for changed requirements and technology advances. Monitoring of industrial R&D program will continue. Systems Concepts and Analysis - Analyze and update planning documents for use in generation and analysis or new missile system concepts. Threat documents will be reviewed, and updated information will be extracted for use in scenarios to determine cost effect of present/future missile systems. Sensors and Control for Guided Projectiles - Initiate integration and testing of g-hardened sensor components and systems for indirect fire application; develop and test hardened sensor components and systems for direct fire application.

Program Element: #6.23.03.A Title: Missile Technology
DOD Mission Area: #523 - Engineering Technology Budget Activity: #1 - Technology Base

4. (U) FY 1982 Planned Program: Anticipated accomplishments by technology are as follows: Sensors - Continue development of track-while-scan radar, acoustic seekers, carbon dioxide beamrider guidance, millimeter wave guidance, and sensor design and signal processing techniques. Guidance and Control - Laser false target rejection algorithms will be missile flight tested. Multiple target handoff correlator hardware will be fabricated and evaluated. Low-cost land navigation techniques and hardware will be developed. Laser designator weapons system simulation (LDWSS) performance in advanced countermeasures and obscurants will be investigated. A small inertial system with update and retargeting capability shall be developed and evaluated. Terminal Guidance - Low-cost modular computers and distributed microprocessors must be developed as soon as possible to meet the requirements of all Army missiles regardless of size, range, and mission. Digital - Demonstrate automated software design methodologies and tools and transfer to a project to lower cost and improve reliability and maintainability of missile software. Continue development of software verification and validation system and tools applicable to distributed processor software to improve missile system software reliability at reduced cost. Simulation Research - Development of an enhanced capability to conduct simulations of complex radio frequency systems in a wider variety of natural countermeasure environments will continue. A wide-angle thermal scene generation system will be implemented in hardware. Initial long-leadtime hardware for a millimeter simulator will be procured. Experimental Systems - Examine threat projections, technological forecasts, and joint plans to assure advances as applied to user requirements; interface fire control and missile seeker radar and demonstrate target handoff; design of adverse environment modular HELLFIRE will be formulated and defined; finalize concept definition and determine best technical approach for the modular missile; fabricate and flight test conceptual hardware to determine viability of using common components with the modular missile. Aerodynamics - The tri-Service/NASA plume model standardization code will be extensively exercised and validated through comparisons with experiments. Rocket sled and/or flight tests will be planned to confirm the adequacy of submissile aeroballistic simulation capability developed in prior years. A new work area in low-cost multiple rocket system aerodynamics will be initiated to investigate problems unique to this class of missile system. Propulsion - Complete service life methodology development with addition of flight and handling load characterization; conduct feasibility demonstration of a low-cost, dual-thrust, minimum signature propulsion system for evolutionary short-range air defense system; complete spinning nozzle demonstration; quantify the exhaust transmission of developmental propellants, liners, insulators, and igniters. Ground Support Equipment - Investigate alternative approaches for low signature launching techniques; evaluate results of dynamically aimed launcher tests; refine design of under armor missile tracking mount for extended ranges; prepare requirements for free flight rocket fire control system; fabricate automatic test equipment system; develop non-petroleum-based container cushioning; develop microcomputer built-in test techniques. Structures - Develop design techniques for advanced composites. Technology Integration - The Army Technology Base Plan will be updated; continually review industrial research and development for consideration in planning. System Concepts and Analysis - Analyze and update planning documents for use in generation and analysis of new missile system concepts. Threat documents will be reviewed, and updated information will be extracted for use in scenarios to determine cost effect of present/future missile systems. Sensors and Controls for Guided Projectiles - Initiate efforts to defeat countermeasures directed against indirect and direct fire systems.

Program Element: #6.23.03.A
DOD Mission Area: #523 - Engineering Technology

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

5. (U) Program to Completion: This is a continuing program. Following areas will be emphasized: (a) reduction of air defense vulnerability to antiradiation missiles; (b) all-weather, countermeasure hardened, fire-and-forget seekers with multimode capability; (c) millimeter wave seekers and beamrider guidance concepts; (d) low-cost inertial guidance; (e) minimum signature propulsion, improved service life; (f) simulation; (g) digital technology for tactical missiles; (h) low signature launching techniques; (i) more accurate under-armor tracking systems; (j) application of composite structures for reduced weight, higher performance, and reduced cost in missile/rocket systems; (k) improved efficiency in structure analysis; (l) automatic tracking algorithms; (m) improved aerodynamic designs to enhance missile performance and effectiveness; (n) development of automatic test equipment for missile systems.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.23.07.A Title: High Energy Laser (HEL) Technology
DOD Mission Area: #521 - Electronics and Physical Sciences (ED) Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	17292	20500	20387	22468	Continuing	Not Applicable
A139	High Energy Laser Technology	17292	20500	20387	22468	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army High Energy Laser (HEL) program seeks expansion of the HEL technology base and exploration of potential use of the HEL in weapon systems for a variety of Army mission applications. The technology base program entails the systematic pursuit of new endeavors in laser science and quantum physics to provide new insights and conceptually innovative laser principles for use in Army mission applications as well as emphasizing improvements in laser components and subsystems, laser system concept development, and lethality verification activities. The program is conducted in concert with the HEL programs of the Navy, Air Force, and the Defense Advanced Research Projects Agency. Laser brassboard systems for specific mission application investigations will be fabricated only after mission viability, system lethality, and technical feasibility have been established to provide a basis for establishing advanced development programs aimed at specific laser weapon system development. Potential Army applications being vigorously pursued are the

C. BASIS FOR FY 1981 RDTE REQUEST: Continue development of continuous wave chemical laser technology and components such as chemical pumps and solid reactant supply systems by con-
tinue the Army/Air Force Joint Short Range Test (JSRT) program, a lethality verification effort for representative targets in realistic scenarios, utilizing the repetitively pulsed electric laser at White Sands Missile Range; continue development of closed cycle circulator technology for electric discharge lasers; continue development of pulsed electric laser technology, including continue development and exploita-
tion of swept-gain superradiance devices; continue development of the data base concerning laser damage to

continue development of pulsed chemical lasers as well as the data base for and propagation characteristics of these devices; continue development of condensed computer codes for use in subsystem and total system modeling programs; conclude the joint Army/Navy continue to pursue an aggressive laser fire control technology program; and continue monitorship of particle beam technology for comparison with high-energy laser technology for Army mission applications.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	17292	20500	20387	Continuing	Not Applicable
Funds (as shown in FY 1980 submissions)	0	1500	2000	Continuing	Not Applicable

Due to the position of the Army High Energy Laser program in the acquisition cycle, the decision was made in FY 1980 to emphasize the exploratory developments aspects of this high technology program and to delay systemization activities. Consequently, the Program Element 6.23.07.A funds have been increased substantially by transferring the funds ($19000 in FY80 and 19286 in FY81) from Program Element 6.33.14.A, High Energy Laser Components, and deleting that program element. The projected funding for FY 1981 is less than shown in the combined FY 1980 submissions since $899 of the anticipated funding was required for higher priority programs.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.23.07.A Title: High Energy Laser (HEL) Technology
DOD Mission Area: #521 - Electronics and Physical Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The overall objective of this project is to develop the High Energy Laser (HEL) technology base to permit future HEL weapon system developments, develop HEL weapon system concepts for viable Army missions, demonstrate the lethality capabilities of HEL systems, and explore the possible utility of unconventional beam technologies, such as particle beams, in radiation weaponry. An HEL has several unique features which could make it a highly effective weapon in a target-rich environment: instant delivery; agile beam; short engagement time; large target-handling capabilities; and capabilities of causing mission abort, short of a hard kill. HEL technology areas supporting eventual weapon system development include: laser devices and components; acquisition/beam control/fire control; propagation/effects/vulnerability; and concept development/validation. The Army's HEL technology program concentrates on developments in these areas for the two leading candidate laser approaches, continuous-wave chemical laser and repetitively pulsed electric laser, as well as further developing other emerging laser approaches and concepts which show promise for radiation weaponry.

G. (U) RELATED ACTIVITIES: In FY 1978 and FY 1979, exploratory development of High Energy Lasers (HEL) was conducted as a task in Program Element (PE) 6.23.03.A, Missile Technology. From FY 1975 through FY 1979, nonsystems advanced development of HEL was conducted under PE 6.33.14.A, High Energy Laser Components. From FY 1977, research in HEL has been conducted under PE 6.11.02.A, Defense Research Sciences. Other HEL development is being accomplished by the Navy (PE 6.37.54.N, High Energy Laser), the 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 (PE 6.23.01.E, Strategic Technology and PE 6.27.11.E, Experimental Evaluation of Major Innovative Technologies). Different battle environments and system platform requirements for the different Services require significantly different HEL technology approaches for each. The Service programs are closely coordinated by the Office of the Under Secretary of Defense (Research and Engineering) to preclude duplication of effort. A number of work efforts in the Department of Defense HEL program are jointly funded and performed. In years prior to FY 1975, Army HEL development was funded under a series of Program Elements - PE 6.21.39.01.A (High Energy Laser Research), PE 6.23.03.A (High Energy Laser Research), PE 6.26.03.A (High Energy Laser Research), PE 6.26.09.A (Project EIGHTH CARD), PE 6.26.12.A, (Project EIGHTH CARD), PE 6.27.03.A (High Energy Laser Research) PE 6.27.05.A (High Energy Laser Research), PE 6.26.21.A (Laser Technology and Applications), and PE 6.36.11.A (High Energy Laser Development, Advanced Laser Development, and Project EIGHTH CARD).

H. (U) WORK PERFORMED BY: The top five contractors are: AVCO Everett Research Laboratories, Everett, MA; TRW, Inc., Defense and Space Systems Group, Redondo Beach, CA; Hercules, Inc., Wagna, Utah; Science Applications, Inc., La Jolla, CA; and W. J. Schafer Associates, Wakefield, MA, with an estimated contract value of $8.8 million in FY 1980. There are 20 additional contractors with an estimated total contract value of $3.4 million in FY80. The principal government organizations conducting this technology program are the High Energy Laser Program Management Office and the Directed Energy Directorate, Army Missile

Program Element: #6.23.07.A Title: High Energy Laser (HEL) Technology
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Laboratory, US Army Missile Command, Redstone Arsenal, AL. Other government organizations performing tasks under this project are: US Army Mobility Equipment Research and Development Command, Fort Monmouth, NJ; the White Sands Missile Range, NM; Naval Research Laboratory, Washington, DC; and the national laboratories at Los Alamos, NM and Livermore, CA.

1. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Technologies necessary for High Energy Laser (HEL) weapon system applications were identified and partially developed through research, subscale demonstrations, and selected scaling experiments. The Mobile Test Unit demonstrator was successfully completed and range tested. Laser Devices and Components Technology -

Acquisition/Beam Control/Fire Control Technology -

Propagation/Effects/Vulnerability Technology -

Program Element: #6.23.07.A Title: High Energy Laser (HEL) Technology
DOD Mission Area: #521 - Electronics and Physical Sciences (ED) Budget Activity: #1 - Technology Base

Concept/Validation -

Developer-User interface has been maintained to develop timely mission and system requirements.

2. FY 1980 Program: A concerted effort will be made in FY 1980 to integrate the technology tasks covered by the exploratory development program element, 6.23.07.A, and the advanced development program element, 6.33.14.A, into a single major program effort so that the high priority tasks may be continued in a logical manner under the single program element, 6.23.07.A, in FY 1981. The major thrusts of the 6.2 High Energy Laser Technology include: (1) New Laser Concepts Development - A new thrust will be initiated to evaluate and further develop
Device and subsystem models will be refined and further developed with the goal of achieving better agreement between model-predicted performance and actual achieved performance for the hardware efforts. New laser concepts and approaches evolving from research and development efforts throughout the laser community will be examined and evaluated for their potential utility to Army applications; (2) Laser Devices/Techniques - Experimental and analytical studies of

will be conducted in order to improve overall laser performance; (3) Laser Phenomenology - The search will continue for creating meaningful

concept development activities; (4) Exploitation/Scale-Up - Swept-gain superradiance action was demonstrated in-house under basic research. This phenomenon has applications in ranging, laser radar and coherent imaging areas as well as the material damage role. The major thrust areas of the advanced development High Energy Laser Components project include: (1) Laser Device Technology -

(3) Beam Control Device Technology -

(3) Propagation/Effects/Lethality - The propogation effort will continue to support the lethality verification and concept definition efforts.

Concept Definition Studies - The role of lasers in the | and (4)

3. FY 1981 Planned Program: The primary thrusts of the two High Energy Laser projects of FY 1980, the exploratory development High Energy Laser Technology and the advanced development High Energy Laser Components projects will be continued under this single, integrated program element. The major thrusts of this program element will be: to continue the advancement of the HEL technology base; to complete the testing of the

Laser Device/Components Technology

Acquisition/Beam Control/Fire Control Technology - Complete the design of the

(Propagation/Effects/Vulnerability - Continue experiments to measure degradation of

System Concept Development - Conceptual design for in coordination with the Training and Doctrine Command (TRADOC) modeling and user agencies. Cost, cost-effectiveness and fieldability issues will be delineated. Unconventional Beam Technology - Particle beam technology developments being conducted under other programs will be monitored to identify possible future Army uses for this technology.

4. FY 1982 Planned Program: Laser Device/Component Technology - Testing and evaluation of the

Acquisition/Beam Control/Fire Control - The preliminary design for a

Propagation/Effects/Vulnerability -

System Concept Development -

will be initiated. Unconventional Beam Technology - Particle beam and other beam technologies will continue to be monitored for possible Army utility.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.01.A
Title: Tank and Automotive Technology
DOD Mission Area: #523 - Engineering Technology
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	12020	11487	15571	19791	Continuing	Not Applicable
AH91-01	Mobility	4736	6251	8753	11486	Continuing	Not Applicable
AH91-02	Systems Integration	2352	3030	3745	4290	Continuing	Not Applicable
AH91-03	Survivability	2185	1687	2773	3340	Continuing	Not Applicable
AH91-04	Support	2747	519	300	675	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army must have ground combat vehicles equal to or superior to those of potential adversaries. These vehicles must be supported by tactical vehicles capable of providing support under all battlefield conditions. This Program Element provides the technology base for the exploratory development of these militarily unique vehicles and their components.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Mobility: Continues efforts at developing new and improved propulsion systems and components, improving fire survivability and Nuclear, Biological, and Chemical protection, enhancing diagnostic capabilities and initiates efforts in developing engine concepts for nonpetroleum fuels and advanced air filtration techniques; (2) Systems Integration: Continues design, analysis, and assessment of future vehicle systems and completes automatic loader breadboard design fabrication and bench testing; (3) Survivability: Continues and initiates additional efforts at developing measures to reduce detectability of vehicles as well as initiates an effort to analyze the trade-offs between combat effectiveness and survivability constraints: (4) Support: Initiates a tactical vehicle development plan.

Program Element: #6.26.01.A
DOD Mission Area: #523 - Engineering Technology

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

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	12020	11487	15571	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	10262	11899	14814	Continuing	Not Applicable

Increased funding for both FY79 and 81 over the FY80 submission reflects increased emphasis in areas of energy and improved air filtration for engines, and heightened emphasis on survivability of combat vehicles. Change in FY80 due to a general reduction in funds, a portion of which was applied against this program.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.26.01.A Title: Tank and Automotive Technology
DOD Mission Area: #523 - Engineering Technology Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This Program Element provides funding to advance the state-of-the-art permitting development of ground combat/tactical systems and subsystems which can better operate against the anticipated threat. The program is subdivided into four main areas: mobility, systems integration, survivability, and support. The mobility effort supports exploratory development of improved vehicle propulsion systems, suspension systems, and related subsystems. The systems integration area deals in development of advanced concepts for future vehicles systems, methodologies for optimizing total system designs, and examination of new techniques to assist the designer in creating an optimized design. Survivability addresses the means by which a vehicle and its crew can best be protected from enemy detection, and measures to be taken to improve survivability, if detected. The support area addresses those facets of vehicle design germane only to the tactical vehicle as opposed to combat vehicles.

G. (U) RELATED ACTIVITIES: Specific programs related to the technical areas of this program element are: PE 6.11.02.A, Defense Research Sciences; 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, Combat Vehicle Propulsion Systems; PE 6.36.31.A, Combat Vehicle Turret and Chassis; 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 Systems Concepts. Close relationship is maintained with other Services and Governmental agencies to preclude duplication of effort. Research and development information concerning tank-automotive technology is being exchanged via data exchange agreements with allied countries.

H. (U) 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 Armament Research and Development Command, Aberdeen, MD; Waterways Experimental Station, Vicksburg, MS; and Cold Regions Research and Engineering Laboratory, Hanover, NH. Major contractors 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; Systems Consultants, Inc., Washington, DC; Goodyear Tire and Rubber Co., St. Marys, OH; Firestone Industrial Products Co., Novlesville, IN; Standard Products Co., Port Clinton, OH; and Battele Laboratory, Columbus, OH.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: (1) Mobility: Completed feasibility work for adiabatic diesel engine which will provide a compact, lightweight, high-output, more fuel-efficient engine with essentially no cooling system. A

Program Element: #6.26.01.A Title: Tank and Automotive Technology
DOD Mission Area: #523 - Engineering Technology Budget Activity: #1 - Technology Base

single-cylinder component engine has accumulated 800 hours to date at near-adiabatic conditions with high-temperature materials to include ceramic piston caps. Conducted advanced turbine exploratory efforts directed at air flow efficiency, effective fuel/air mixing and combustor efficiency. A test engine successfully demonstrated ceramic coatings to control heat stress. Two test rigs are being completed to demonstrate high wheel travel, externally mounted suspensions of reduced weight. The independent external system intended to increase cross-country speed and increase hull volume on a 40,000-lb rig is 70% completed. The Loopwheel, a radically new suspension that promises reduced weight and improved performance, is presently being tested on a 3000-lb test rig. (2) Systems Integration: Published the Armored Combat Vehicle Development Plan and Tank Science and Technology Base Development Plan, both being utilized within the Army to plan, coordinate, and execute combat vehicle development efforts. Conducted design and analysis of advanced armor on future Soviet combat vehicles to extrapolate performance criteria. Completed initial feasibility study to incorporate an automatic ammunition-loading system in a modified tank turret with a 120mm gun. Completed initial concept design for the next-generation main battle tank. Completed conceptual designs for a future infantry vehicle and various other advanced fighting vehicles. (3) Survivability: Laser designator warning/missile ignition optical detectors are under development. Feasibility of acoustic detection of attack helicopters has been demonstrated. Radar/millimeter wave signatures were examined on various combat vehicles with radar absorbing material and hardware applied in order to develop means by which to reduce such signatures. Joint evaluations were conducted with the Air Force to determine effectiveness against antitank missile seekers. Signature reduction efforts have utilized track skirts, engine exhaust deflectors, armor shields, roadwheel covers and other techniques to reduce infrared emissions. A photometric computer model and test methodology have been developed for low-light-level laser reflectance testing. An acoustic detection model is being developed and tested. Developed vented ammunition compartment design criteria and initial concept formulation for combat vehicles.

2. (U) FY 1980 Program: (1) Mobility: Continues efforts at improving fire survivability of ground combat vehicles. Advanced adiabatic technology in support of high-temperature componentry also continues. External suspension and loopwheel testing continues. (2) Systems Integration: The 120mm auto loader breadboard hardware will be developed to further identify unknowns and to quantify performance levels. Concept design and analysis of a future main battle tank will be completed. (3) Survivability: Based on previous testing, a methodology will be developed for predicting the emitted and reflected thermal image of concept combat vehicles. A vented ammunition compartment for a combat vehicle will be fabricated and the concept validated through live firing. Integrated passive countermeasure systems, combining radar, seismic, photometric, infrared, laser, and acoustic susceptibility reduction techniques will be investigated. Various countermeasure concepts will then be developed, fabricated, and installed on combat vehicles for evaluation. Joint field evaluation with the US Air Force will continue. Feasibility hardware for the acoustic detection and location of threat helicopters will be demonstrated on an air defense vehicle. (4) Support: Fabrication of advanced composite materials and structures such as springs, frame rails, and drive shafts of graphite/epoxy will be completed and testing will begin.

Program Element: #6.26.01.A
DOD Mission Area: #523 - Engineering Technology

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

3. (U) FY 1981 Planned Program: (1) Mobility: Investigation of friction reduction techniques for adiabatic engines will continue using high-temperature ceramic materials and designs. A determination will be made concerning compatibility of alternate fuels for use in combat vehicles. An advanced air filtration system will be explored. Efforts will be initiated on a new high-temperature recuperator for the advanced turbine. Prototype bidirectional suspension will be evaluated; such a suspension offers increased ride comfort and stability and, therefore, increased speed. Laboratory testing will be conducted to determine rapid engine shutdown methods to reduce fire damage. (2) Systems Integration: The 120mm ammunition automatic loader breadboard fabrication and testing will be completed. A comprehensive three-dimensional analysis methodology for the evaluation and testing will be completed. Methodology for the evaluation of the interaction between chassis and turret dynamic effects will be developed for use in the design of vehicle concepts. The methodology will provide a tool capable of assessing the impact of changes in gun stabilization compensation, vehicle mass, and suspension systems on total concept performance. (3) Survivability: Vented ammunition compartment designs will be adapted to various combat vehicle concepts based on the evaluation of previous years' analysis. Using image analysis techniques, detection criteria will be quantified to control emitted/reflected optical images of combat vehicles in order to reduce vulnerability. Active vehicle countermeasure techniques, such as jammers, will be examined. (4) Support: Tactical vehicle concept designs will be developed for future test rig fabrication.

4. (U) FY 1982 Planned Program: (1) Mobility: Advanced adiabatic component technology efforts will concentrate on maximizing ceramic coating material usage. Selected advanced turbine ceramic-coated components will begin endurance testing. Engine concepts for burning a broad range of both synthetic and conventional fuels will continue leading to determination of engine design changes required to enable efficient operation on selected fuels. Advanced air filtration efforts will progress to selection and initial evaluation of promising concepts. A breadboard adaptive suspension system will be analyzed under simulated field conditions and design parameters defined for follow-on effort; the adaptive suspension system senses terrain changes in front of a tracked vehicle and through actuators, begins movement of track/suspension so as to "smooth-out" the terrain. Fabrication of a prototype fixed pitch positive guided track system will be completed and a concept design of a terrain-compliant suspension system will be initiated. Four hundred-hour North Atlantic Treaty Organization test of fire-resistant fuels will be conducted to determine their ability to reduce vehicle fire hazard. Fire-extinguishing agents that are more effective and less toxic than those presently used will be investigated. An investigation of ballistic grills, a feasibility assessment of active armor and adjustable modular add-on armor will continue. (2) Systems Integration: Math models to simulate vehicles will be refined to more closely approximate field environment. Driver-vehicle interaction will be studied in order to incorporate realistic steering, acceleration, and braking effects in the model. (3) Survivability: Methods for suppressing the dust plume of tracked vehicles will be investigated. Narrow spectral band emitters will be applied to the interior lighting systems of vehicles together with shrouds, shields, and narrow band filters on the vehicle exterior in an effort to reduce vehicle susceptibility to optical detection. (4) Support: Effort will be conducted in reducing noise in tactical vehicles in consonance with government guidelines.

Program Element: #6.26.01.A
DOD Mission Area: #523 - Engineering Technology
Title: Tank and Automotive Technology
Budget Activity: #1 - Technology Base

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.03.A
Title: Large Caliber and Nuclear Technology
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	24619	24482	30291	34101	Continuing	Not Applicable
AH18-01	Armored Fighting Vehicles (Large Caliber Systems)	5050	1100	1000	1900	Continuing	Not Applicable
AH18-02	Armored Fighting Vehicles (Medium Caliber Vehicles)	3100	2500	2000	0	Continuing	Not Applicable
AH18-03	Improved Sensing Munitions (ISM)	280	1150	939	1400	Continuing	Not Applicable
AH18-04	Infantry Armament Systems	1025	1250	1200	1700	Continuing	Not Applicable
AH18-05	Artillery Armament Systems	2390	1600	1800	2800	Continuing	Not Applicable
AH18-06	Advanced Artillery Systems Testbeds	2360	1700	1900	2000	Continuing	Not Applicable
AH18-07	Enhanced Self-Propelled Arty Weapons System (ESPAWS)	-	2300	3100	500	Continuing	Not Applicable
AH18-08	Combat Engineer Armament Support	425	600	700	1040	Continuing	Not Applicable
AH18-09	Energetic Materials Technology	1275	1925	1925	2350	Continuing	Not Applicable
AH18-10	Weapons Technology	970	1900	1900	2380	Continuing	Not Applicable
AH18-11	Munitions Technology	1550	1100	1100	2700	Continuing	Not Applicable
AH18-12	Weapons Munitions Interface	1469	2162	5900	6900	Continuing	Not Applicable
AH18-13	Nuclear Munitions Technology	1240	1470	1427	1500	Continuing	Not Applicable
AH18-14	Fuze Technology	3485	3725	5000	5931	Not Applicable	Not Applicable
AH18-14	Training Munitions	-	-	400	1000	Not Applicable	Not Applicable

Program Element: #6.26.03.A
Title: Large Caliber and Nuclear Technology
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Large Caliber and Nuclear Armaments Technology program performs exploratory systems development and necessary supporting research to further the state-of-the-art in weapons, munitions, and their interfaces. The output of this program is used in defining promising revolutionary systems as well as product improvements associated with evolutionary development. The program scope covers the system-oriented technical areas of armored fighting vehicle armament (75mm, 105mm and 120mm), infantry armament systems (indirect and remote fire systems and 81mm recoilless gun for Military Operations on Urbanized Terrain), artillery armament systems (target-seeking munitions howitzer testbeds and light artillery division system), and combat engineer support (mines and demolition systems). Project scope also emphasizes support technologies in the areas of energetic materials (explosives, propellants, and pyrotechnics), weapons, munitions, weapon/munition interface, nuclear technology, fuze technology, and training munition technology. These efforts form the foundation for all subsequent weapon and munition advanced developments, engineering developments as well as many product improvement programs. A fundamental commitment has been made to address requirements and priorities as defined in the Science and Technology Objectives Guide, FY 1980 (STOG-80).

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Exploratory development efforts for the 75mm automatic cannon/ammunition system will be continued to completion. Transition of this effort to advanced development is delayed one year due to technical problems with the cannon and ammunition encountered during prototype ballistic testing. This system will satisfy the Army's requirement for a smaller, more compact armament system for lightweight armored fighting vehicles to defeat future medium to heavy armor threats. The Improved Sensing Munitions (ISM) effort, initiated in FY80, will focus on the development of simple, low-cost sensors, long standoff warheads, and the development of new concepts utilizing the technological advances gained through the successfully demonstrated Smart Target Activated Fire-and-Forget (STAFF) and Sense and Destroy Armor (SADARM) systems. Exploratory development of the Canard Homing Artillery Modular Projectile (CHAMP) and the Artillery Registration and Adjustment System will be completed. These systems provide for terminally guided extended range artillery with increased accuracy and reduced logistic requirements. The advanced Artillery Systems Testbeds effort will continue with emphasis on the completion of system integration including on-board fire control, compressible fluid recoil, and autoloader. System performance testing will be initiated. This program will provide a baseline for the next generation self-propelled howitzer system. The Enhanced Self-Propelled Artillery Weapon System (ESPAWS) program, initiated in FY80, which permits evaluation of the alternate approaches of product improvement of the M109A1 155mm howitzer, the use of existing or improved NATO foreign howitzer systems or a new Army concept for the future 155mm howitzer system, will be completed leading to concept definition of the Army's next generation Self-Propelled Howitzer. Technology base effort in energetic materials, Insensitive High Explosives and Propellants (IHEP), wear and erosion reduction by means of coatings, liners, and additives, nuclear munitions safing and arming components, training munitions technology and air defense fuzing, missile and rocket fuzing, special munition fuzing will continue.

Program Element: #6.26.03.A
Title: Large Caliber and Nuclear Technology
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	24619	24482	30291	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	25369	24772	24743	Continuing	Not Applicable

The decrease in FY 1979 funding over the FY80 submission is due to movement of funding to higher priority Army programs. The increase in FY 1981 funding is to conduct feasibility demonstration of artillery registration and adjustment system; for evaluation of insenstive high explosive propellent and initiation of technology efforts for an enhanced self-programed Artillery Weapons System (ESPAWS). The FY80 decrease is the result of a general reduction by Congress.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.26.03.A
Title: Large Caliber and Nuclear Technology
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

F. (U) 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, and combat engineering. The program also supports the included technologies of energetic materials (explosives, propellants, and pyrotechnics), weapons, conventional munitions, nuclear munitions, and weapon/munition interface, ammunition fuzing and training munitions. 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.

G. (U) 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; 6.26.15A/AH 74, Nuclear Munitions; and 6.26.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 Element 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 duplication.

H. (U) 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 Florida University, Gainsville, FL; Firestone Tire & Rubber, Akron, OH; Maremont, McGregor, OK; Westinghouse Electric Corporation, Washington, DC; Chemetal Ind, Los Angeles, CA; McDonnell Douglas, Titusville, FL; and numerous other small contractors.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: A prototype Top-Attack Smart Target Activated Fire-and-Forget (STAFF) projectile was successfully demonstrated. Refinements of components (countermeasures, sensors, and warhead) will continue for further application to future systems. Howitzer testbeds I & II were tested in the Human Engineering Laboratory Battalion Artillery test (HELBAT VII) exercise. This exercise is a joint developer/user effort to determine the feasibility of new artillery concepts, i.e., level of automation for fire control systems integration of target acquisition systems and artillery ammunition resupply systems. The results revealed a reduction in response time, crew size, and weapon pointing accuracy with on-board location and tube reference equipment. A multilug tank cannon breech was fabricated for potential use with the 120mm tank gun. Fatigue tests indicate improved life expectancy for the 120mm tank gun with this breech.

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DOD Mission Area: #523 - Engineering Technology (ED)

Title: Large Caliber and Nuclear Technology
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2. (U) FY 1980 Program. Effort will be initiated to establish computer modeling for an integrated fighting vehicle system to include fire control, ammunition, armament, and other ancillary equipment. Exploratory development of the XM815 Chemical Energy round will be completed. A Technical Development Package (TDP) review and initiation of outline development plan for the Medium Caliber Antiarmormor Automatic Cannon (MCAAC) as well as computer modeling and testing will be conducted. In the improved sensing munitions area, multiple submission configurations will be designed and flight tested, new warhead concepts investigated, infrared and 94 GHz sensors developed. A low-pressure, conventional recoilless gun, designed in FY 1979, will be fabricated to demonstrate the ability of a lightweight 81mm expendable recoilless gun to meet urban warfare requirements. The Artillery Registration and Adjustment System (ARADS) will be fabricated and subjected to laboratory testing. Testing and projectile integration of Canard Homing Artillery Modular Projectile will be conducted. Complete prototype components for Compressible Fluid Recoil Mechanism for 155mm howitzer system; initiate a a concept for loading projectile and propellent charge; initiate a design for a fire control system to include position location, on-board tube reference, on-board ballistic computation, and a digital radio communication system compatible with the Tactical Fire Direction System. Concepts will be solicited from industry for the new Enhanced Self-Propelled Artillery Weapon System. New concepts for future mass scatterable mines will be examined. Technology materials, including insensitive high explosive and propellant (IHEP), tube wear and erosion, components for nuclear munitions, and ammunition fuzing will be continued

3. (U) FY 1981 Program: The Computer Aid Design technique for an integrated tank system development plan will focus on the selection of concepts to be established for design of hardware. Exploratory development of Medium Caliber Antiarmor Automatic Cannon System will be completed. The Improved Sensing Munitions effort will include development of a stable iron rod warhead and sensor packaging and countermeasures. Component designs will be completed for integration into the Howitzer Test Bed III Vehicle, which will be subjected to total system testing in FY 1982. Fabrication and testing of the autopilot design for CHAMP will be completed. A concept feasibility demonstration of the Artillery Registration and Adjustment System will be conducted. Based on an evaluation of contractor's Enhanced Self-Propelled Artillery Weapon System concepts, a requirement document will be initiated to enable transition into advanced development. Computer analysis of emplacement techniques for wide area mines will be conducted. Continuation of Technology base efforts in energetic materials, including IHEP, gun tube wear and erosion, components for nuclear munitions and fuzing.

4. (U) FY 1982 Planned Program: The Computer-Aided Design technique for an integrated tank system development plan will center on testing concepts generated in FY 1981 to determine practicality, accuracy, and payback of this technique for system designs. ISM sensor and warhead effort will continue. A concept feasibility demonstration of advanced smart target activated fire-and-forget components will be initiated; lethality estimates will be provided for indirect and direct fire ISM concepts. Component testing and system integration will lead to a concept feasibility demonstration of CHAMP in FY83. Continue testing of the HTB III Integrated System. Complete reduction of data to determine the feasibility for incorporation of components into

Program Element: #6.26.03.A
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the new Self-Propelled howitzer Sytem. Technology base effort will be continued for non-system-related advanced development programs.

Component testing and system integration will lead to a concept feasibility demonstration of CHAMP in FY83. Field tests of HTB III will provide data for the evaluation of the integrated systems and advantages accrued over existing systems. Technology base effort will be continued for all components for artillery, combat vehicle, mortars, mines and countermines, and training munition systems for application to future munitions development programs.

5. (U) PROGRAM TO COMPLETION: This is a continuing effort.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.17.A
Title: Small Caliber & Fire Control Technology
DOD Mission Area: #523 - Guns and Related Technology
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	9695	8511	10347	11514	Continuing	Not Applicable
AH19A	Joint Services Small Arms Program	0	2218	1797	2200	Continuing	Not Applicable
AH19B	Combat Vehicle Armament	2063	1710	1900	2118	Continuing	Not Applicable
AH19C	Aircraft Armament	720	600	800	900	Continuing	Not Applicable
AH19D	Light Weapons	1867	0	0	0	Continuing	Not Applicable
AH19E	Short Range Air Defense	1959	763	1850	1926	Continuing	Not Applicable
AH19F	Fire Control Technology	997	1220	1600	1850	Continuing	Not Applicable
AH19G	Armaments Technology	2089	1250	1550	1600	Continuing	Not Applicable
AH19A	Application for Metallic Materials	0	750	850	920	Continuing	Not Applicable

B. (U) 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 for all gun systems and small caliber weapons and munitions can be initiated to improve existing weapon systems and to develop new weapon systems to meet the perceived threat. The focus is on exploratory development in fire control, munitions, weapons, and material applications which is intended to solve critical problems in fire control and small caliber weapon systems design, effectiveness and reliability. The intent is to produce an integrated program of analysis, experimentation, and test demonstration that advances the state-of-the-art and leads to concept validation. Beginning in FY 1981, this element will support the Army's share of exploratory development in small arms under the direction of the Joint Services Small Arms Program (JSSAP).

C. (U) BASIS FOR FY 1981 RDTE REQUEST: The funds will support the development and maintenance of a small caliber and fire control technology base encompassing the technical areas related to armament and fire control for combat vehicles, aircraft, light weapons and air defense, and to further investigate the broad areas of fire control and small caliber armaments.

Program Element: #6.26.17.A
DOD Mission Area: #523 - Guns and Related Technology

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

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	9695	8511	10347	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	9448	8598	10314	Continuing	Not Applicable

Minor increase in FY79 due to reprograming increased scope of work for fire control; FY80 decrease is the result of a general Congressional reduction, and FY81 minor increase due to increase in scope of work in area of fire control.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.26.17.A
Title: Small Caliber & Fire Control Technology
DOD Mission Area: #523 - Guns and Related Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The product of this effort is used to conceptualize revolutionary fire control, weapon and munitions systems as well as to define methods for improving the current systems to extend their useful life. The scope of the program covers the system oriented areas of combat vehicles, aircraft armament, light weapons, and short range air defense, and the basic technology areas of fire control, armaments and metallic material applications. The investigations develop both the hardware and the analytic tools necessary to assess system performance and to identify problem areas. The resulting data base forms the foundation for all subsequent fire control and small caliber weapon and munition advanced and engineering developments.

G. (U) RELATED ACTIVITIES: The technical areas in this program are related to the following program elements: 6.26.03.A, Large Caliber and Nuclear Technology (AH18); 6.26.18.A, Ballistic Technology (AH80); 6.22.03.A, Aircraft Weapons Technology (DH96); 6.21.05.A, Materials Technology (AH84); and numerous other advanced and engineering development projects. The coordination of similar efforts conducted by the Air Force and the Navy is accomplished by interagency meetings, and tri-service reviews and workshops to encourage information exchange and preclude unnecessary duplication. A Joint Services Small Arms Program has been chartered with a member from the Army, Navy, Marine Corps, Coast Guard, and Air Force to coordinate development of individual and crew served weapon systems (shotguns, grenade launchers, sights, mounts, ammunition, and ancillary equipment) up to and including caliber 0.60.

H. (U) WORK PERFORMED BY: The in-house work is conducted at the US Armament Research and Development Command facilities located at Dover, NJ, and Aberdeen and Edgewood, MD. The five largest contractors are the Raytheon Corporation, Waltham, MA; the Hughes Aircraft Corporation, Culver City, CA; AAI Corporation, Cockeysville, MD; Baird Corporation, Bedford, MA, and Analytic Sciences, Redding, MA. In addition, there are small contracts with 18 additional vendors with a total value of $715,000.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Demonstrated an active, laser miss distance sensing concept designed to increase second round probability of hit. Completed the design of a baseline fire control test bed. Completed initial design and flight tests of heavy metal long rod penetrators for the 25mm cannon (Bushmaster System). Demonstrated the feasibility of a modular, low cost general purpose heavy machine gun concept. Successfully completed tests on thin wall prototype steel cartridge cases and Rheinmetall, Federal Republic of Germany, flat cone shaped charge ammunition technology. Completed laboratory test plan for evaluating prototype air-to-air self defense systems. Completed hardware fabrication of a multishot grenade launcher and a companion laser rangefinder sight for user feasibility evaluation. Completed laboratory demonstration of medium support weapon and submachine gun concepts for user evaluation. Completed the design of a dual frequency millimeter wave air

Program Element: #6.26.17.A
DOD Mission Area: #523 - Guns and Related Technology

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

defense track radar and initiated fabrication. Demonstrated major improvements in gun pointing accuracy using the analog turret control concept on a six degrees of freedom simulator. Completed laboratory demonstration of a Fourier transform correlation concept for automatic tracking in a high clutter environment. Evaluated low vulnerability packaging and binders for caseless ammunition. Completed a gun rifling formability simulation model to assist in design of future weapon systems.

2. (U) FY 1980 Program: Complete the field test on prototype advanced tracking technology fire control unit. Complete the integration of the correlation automatic tracker into the baseline fire control test bed. Continue flight tests and evaluation of heavy metal 25mm ammunition concepts for the Bushmaster System. Complete initial brass board development of the general purpose heavy machine gun for a joint service user evaluation. Complete user evaluation of the multishot grenade launcher and the laser rangefinder sight. Complete the concept design of the aircraft armament active recoil modular controller (XM230 7.62mm chaingun and universal turret system). Complete the feasibility test of fire control systems designed for helicopter air-to-air combat. Complete the prototype fabrication of the dual frequency air defense radar. A liquid crystal reticle will be integrated into the AN/VSG-2 tank thermal sight and its performance evaluated. Complete packaging and binder vulnerability tests of the caseless ammunition concept. The feasibility of using 926C steel as a shell body to increase lethality of high fragmentation artillery rounds will be demonstrated. The composition and design of advanced warhead materials will be investigated to optimize lethality/cost. The feasibility of using the electro-slag remelted process to produce steel cartridge cases will be evaluated.

3. (U) FY 1981 Planned Program: Evaluate candidate algorithms for lead prediction of maneuvering ground targets in laboratory tests. Complete concept field test of the correlation auto tracker designed to assist tank gunners in locating and tracking moving and multiple targets. Complete initial design and evaluation of a lightweight automatic weapon concept as a possible replacement for the caliber .50 machine guns currently used on combat vehicles. The design requirements for a digital turret controller to assist the gunner in aiming a high impulse gun will be developed. Various air-to-air fire control components and armament concepts will be evaluated to determine feasibility for transition to advance development. The dual frequency air defense track radar designed for a low probability of intercept and simultaneous enemy aircraft locating and tracking capability will be assembled and field tested. The use of passive acoustic sensor for an air defense system will be evaluated. The laboratory test of a passive miss distance sensor concept to increase probability of second round hit will be completed. The use of a programmable signal processor in improving radar detection/classification range will be investigated. The exploratory development of small caliber caseless ammunition will be completed. The analysis of unalloyed depleted uranium penetrators will be completed. Complete a joint service user evaluation of a caliber 50 prototype heavy combat weapon concept as a possible replacement for the M2/M85 class machine guns. Complete engineering development and transition to advance development a medium support weapon and multishot grenade launcher. This effort involves 111 professional and 28 support personnel.

Program Element: 6.26.17.A
DOD Mission Area: 521 - Guns and Related Technology

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

4. (U) FY 1982 Planned Program: Improved digital computer techniques will be implemented on the baseline fire control test bed and evaluated. Field evaluation of lead prediction algorithms for maneuvering ground targets will be completed and, if successful, recommended for product improvement to existing tank fire control systems. The trade-off study of the High Impulse Precision Armament System will be completed and prototype hardware fabricated for advanced technology demonstration. Complete exploratory development of low drag, air defense 35-40mm ammunition designed to reduce time of flight, thus increasing probability of hit against moving targets. The concept development and evaluation of the dual frequency track radar will be completed and, if successful, transitioned to advanced development. Design definition of the mechanism and fire control for the advanced rifle systems will be completed. A concept for an advanced submachine gun will be developed and feasibility hardware fabricated for user evaluation.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.18.A
DOD Mission Area: #523 - Engineering Technology

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

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	18439	16304	19589	23780	Continuing	Not Applicable
AH80-A	INTERIOR BALLISTICS	3250	2951	3589	4306	Continuing	Not Applicable
AH80-B	LAUNCH AND FLIGHT DYNAMICS	1010	900	1209	1144	Continuing	Not Applicable
AH80-C	FIRING TABLE TECHNIQUES AND PRODUCTION	898	900	1209	1300	Continuing	Not Applicable
AH80-D	WARHEAD MECHANICS	2830	2200	3398	2720	Continuing	Not Applicable
	ARMOR DYNAMICS	4460	2565	2011	2685	Continuing	Not Applicable
AH80-F	VULNERABILITY METHODOLOGY	1000	1500	1435	2337	Continuing	Not Applicable
AH80-G	TARGET VULNERABILITY AND LETHALITY	2141	1800	1355	2050	Continuing	Not Applicable
AH80-H	VULNERABILITY REDUCTION AND SURVIVABILITY	515	1000	709	1490	Continuing	Not Applicable
AH80-I	WEAPON SYSTEM ANALYSIS AND MODELING	1550	992	1493	1750	Continuing	Not Applicable

Program Element: #6.26.18.A Title: Ballistics Technology

DOD Mission Area: #523 - Engineering Technology Budget Activity: #1 - Technology Base

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
AH80-J	FIRE CONTROL TECHNOLOGY	865	1196	1204	1680	Continuing	Not Applicable
AH80-K	APPLIED PROBABILITY AND STATISTICS		300	514	550	Continuing	Not Applicable
	BASOPS ASSESSMENT	-----	-----	1463	1768	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for exploratory development efforts in the technical areas shown in paragraph A. Hardware constructed within this program is limited to proof-of-concept laboratory prototypes. The program is required as a source of technology innovation and advancement that can be exploited by system development under advanced development (6.3) and engineering development (6.4) program elements. Primarily, all efforts within this program element support the Army Science and Technology Objectives (STOG) for the formulation and prioritization of user-oriented requirements for the Mid- to Long-range planning periods. The STOG serves as the basis for structuring Reasearch and Development programs at the entry level of the Science and technology base of the development cycle. This base program is primarily concerned with both research and Exploratory development and provides for the initial definition of technological innovations or advancements before they progress into viable weapon system applications. The efforts within this program are related to close combat, fire support, other combat support, and Air Defense systems.

C. BASIS FOR FY 1981 RDTE REQUEST: Emphasis will continue on the generation and application of advanced ballistics technology to high-impetus propellants, traveling charges for hypervelocity gun concepts, the production of firing tables and associated ballistic data for developmental systems, and techniques to desensitize ammunition to the effects of fire and shock, thereby reducing combat losses of ammunition and vehicles. The aereodynamic performance of subcaliber, unusual shape projectiles and special ammunition will be confirmed through ballistic range tests.

Experiments and modeling efforts will be directed to reducing muzzle blast overpressures from modern, high-performance artillery firing at high charge zones. Vulnerability data will be developed for a

broad spectrum of materiel and equipment; benefits of various vulnerability reduction techniques will be evaluated, including a concept to improve survivability of helicopter rotor blades.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

RDTE	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
Funds (current requirements)	18439	16304	19589	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	18009	16512	20578	Continuing	Not Applicable

(U) The difference in fund profiles between the FY 1981 and the FY 1980 Congressional Descriptive Summaries for this program element is due to movement of funds to higher priority Army requirements. The increase in actual funds versus programmed funds for FY79 is for initiation of exploratory efforts on insensitive high explosive propellants. The FY80 difference is the result of a general Congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.26.18.A Title: Ballistics Technology
DOD Mission Area: #523 - Engineering Technology Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program element is to develop and maintain a ballistic technology which assures a solid foundation upon which advanced and engineering development of weapon systems can be initiated and sustained. The Ballistics Technology Program focuses on describing closed system ignition and combustions processes (propulsion dynamics); interactions between high-pressure gases with the atmosphere (propulsion dynamics and launch and flight dynamics); dynamics of projectile flight (launch and flight dynamics); and the delivery of projectile energy to a target (warhead mechanics and terminal effects and armor dynamics). The capability to describe ballistic phenomena comprehensively is critically important to the successful prosecution of advanced and engineering development of weapon systems. Through that capability, state-of-the-art concepts can be identified, developed, and evaluated with minimum costly and time-consuming trial-and-error experiments. In addition, the Ballistics Technology Program develops vulnerability assessment techniques which are used Army-wide by development and analysis agencies to identify system weaknesses and appropriate design changes before production. This formalized vulnerability assessment/reduction effort has improved the survivability of recently developed Army materiel. Equally important, the effort pinpoints and quantifies weaknesses in enemy equipment which are exploited by weapons designers and military doctrine analysts.

G. (U) RELATED ACTIVITIES: These Ballistic Technology efforts are related to development activity in Large Caliber and Nuclear Technology, 6.26.03.A; Small Caliber and Fire Control Technology, 6.26.17.A; and Tank and Automotive Technology, 6.26.01.A. Also, Ballistics Technology efforts are related to similar efforts conducted by the Air Force and the Navy. Visits by other service technical personnel and interagency transfer of knowledge preclude unnecessary duplication of efforts.

H. (U) WORK PERFORMED BY: Approximately 75 percent of the work is conducted in-house at the US Army Armament Research and Development Command facilities located at Aberdeen Proving Ground, MD (Ballistic Research Labooratory), and Dover, NJ. Other participating Army facilities are the US Army Missile Command, Huntsville, AL; and the US Army Test and Evaluation Command, Aberdeen Proving Ground, MD. Major contract support is provided by New Mexico Institute of Mining and Technology, Socorro, NM; Lawrence Livermore Laboratories, San Francisco, CA; Oak Ridge National Laboratory, Oak Ridge, TN; and Falcon Research and Development, Denver, CO. Other support is provided by an additional 17 contractors, some of whom are unknown because bids will be competitive, at a total cost of $2800 thousand.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments:

Program Element: #6.26.18.A
DOD Mission Area: #523 - Engineering Technology

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

Technological advances in terminal ballistics and interior ballistics (propellant optimization) were extended to the 120mm tank gun. Full-scale ballistic tests of a low-vulnerability propellant formulation were completed. For the traveling charge gun program, the baseline one-dimension parametric code, the initial evaluation of super burning rate propellants, and the final evaluation of consolidated charge formulations were completed. In launch and flight dynamics the efforts were for projectiles experiencing the change from subsonic to sonic velocities and the prediction of aerodynamic characteristics not dependent upon air viscosity effects. Aerodynamic characteristics of special shape projectiles, e.g., semicorkscrew projectiles were determined by wind tunnel testing and ballistic range tests. Significant achievements in millimeter wave technology culminated in demonstration of the technical feasibility of application as a Target Tracking Radar System and Beam Rider Missile System. Efforts in improved sensing munitions were exploited to define and validate sensor-target-background interaction parameters for flyover antiarmor munitions.

2. FY 1980 Program: The traveling charge concept will continue to be the principal propulsion candidate for a hypervelocity gun concept. Major efforts on advanced antitank warheads will be completed; warhead areas to be explored are the development of selective initiation schemes to produce different shaped charges from the round.

There will be a reemphasis on a broad-based program to support future kinetic energy weapons systems development. Results should provide optimization information for kinetic energy penetrators. Efforts supporting obscuration/obscuration mitigation technology will include propagation/attenuation measurements on newly developed Army-Navy broadband obscurants; small-scale field evaluations of obscuration mitigation techniques; and analysis of the effects of multispectral screening agents of current and proposed armament systems, with particular emphasis on improved sensing munitions.

3. (U) FY 1981 Planned Program: The feasibility demonstration of the traveling charge hypervelocity gun will be completed; efforts in that area will be initiated to improve the structural integrity of the traveling charge and the charge/projectile interface. Launch dynamics work will be directed toward producing design characteristics for a low-dispersion tank gun system, constructing a model for predicting the time-dependent acoustics of various combinations of

gun/brake/and suppressions, and providing the firing tables for US land combat weapons. High payoff is expected from work on alternate-shaped charge liner fabrication technologies. Full-scale conceptual penetrator designs will be carried out and a technique for minimizing behind-armor debris will be designed. Other accomplishments will include vulnerability analysis of hazards in current shipment methods and storage configurations (both long-term reserve and under combat conditions) vulnerability techniques following from improved knowledge of explosive and propellant sensitivity; structural response codes for the assessment of vulnerability of military targets to nuclear attack; establishment of vulnerability/lethality detachments at various commands; and breadboard demonstration of feasibility of 140-gigahertz (GHz) millimeter wave application to Beam Rider Air Defense Systems (BRADS). To conduct these efforts 155 Professional and 140 Technical Support Personnel are involved.

4. (U) FY 1982 Planned Program: Determine effects of barrel rifling, eccentricity, and recoil mechanism perturbation on small-caliber system performance; model the launch dispersion effects of muzzle devices; produce firing tables and ballistic data; show how to limit sympathetic detonation hazard in munitions; incorporate new measures of vulnerability for tanks into system modules; establish and monitor vulnerability/lethality detachments; produce data needed for spare parts provisioning; provide updated and revised data for vulnerability reduction; demonstrate feasibility of sensor systems for a guided projectile; demonstrate a phase coherent solid state radar operating at 217 GHz; and determine the effects of multispectral developmental obscurants on beamriders, improved sensing munitions, and fire control systems; and determine the effects of multispectral developmental obscurants on beamriders, improved sensing munitions, and fire control systems.

5. (U) Program to Completion: This program is a continuing effort.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.22.A Title: Chemical Munitions and Chemical Combat Support
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5731	6615	5751	7131	Continuing	Not Applicable
A554	Chemical Munitions and Chemical Combat Support	5731	6615	5751	7131	Continuing	Not Applicable

B. (U) 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 United States (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 chemical munitions (binary lethal and incapacitating) and chemical combat support materiel (smoke 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 weapons systems in meeting stated Army requirements. Additionally, the Army has been designated the Executive Agent for RDTE of chemical weapons and chemical-biological defense materiel 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 the only source for such support.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: To provide technical support to munitions development to assure the most efficient/least risk munition development and determine scale-up to munition parameters for selected intermediate volatility or highly persistent agents for weaponization purpose. Continue investigation of concepts for bulk mixing techniques and modular munitions, evaluation of potential new (improved) binary agents, and search for practical methods for field assessment of simulants. Develop analytical quality control standards for new binary munitions design and shelf-life evaluation. Search for and evaluate new potential incapacitants that are effective by inhalation and absorption through the skin. Continue evaluation of candidate infrared and multispectral smoke/obscurants to include acute and subchronic toxicity testing. Continue development of incapacitating and lethality models to assess the combined chemical and fragmentation trauma effects of chemical munitions.

Program Element: #6.26.22.A Title: Chemical Munitions and Chemical Combat Support
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5731	6615	5751	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	5731	6675	6374	Continuing	Not Applicable

(U) Decreased funding in FY 1981 is the result of reprogramming to higher priority nonchemical programs. The decrease in FY80 is the result of a general Congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.26.22.A Title: Chemical Munitions and Chemical Combat Support
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program supports the entire Department of Defense (DOD) chemical technology 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 multispectral 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 civil disturbance control and tactical irritant agents, development of concepts for their use, and the establishment of feasibility of munitions responsive to the concepts.

G. (U) RELATED ACTIVITIES: Investigations under this project provide the essential exploratory effort in lethal, incapacitating, and civil disturbance control agents and munitions, smoke and multispectral obscurant 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 (Chemical-Biological) Defense and General Investigations."

H. (U) WORK PERFORMED BY: Contractors - ASH Stevens, Inc., Detroit; MI; Batelle, Columbus, OH; Foxboro Analytical, South Norwalk, CT; Brunswick Inc., Marion, VA; SRI International, Birminghan, AL; Barnes Engineering, Stanford, CT; Aerodyne Research, Burlington, MA; R&D Associates, Santa Monica, CA; Rahtech, Madison, WI; American Histological Laboratories, Bethesda, MD; Stanford Research, Menlow Park, CA; In-house developing organization - US Army Chemical Systems Laboratory, Aberdeen Proving Ground, MD.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Over the past 20 years, a variety of flame and incendiary, lethal chemical, tactical riot control, and civil disturbance control agent munition systems have been developed and fielded. To enhance safety and security, the binary concept has been successfully applied to the development of two artillery chemical projectiles. This

Program Element: #6.26.22.A Title: Chemical Munitions and Chemical Combat Support
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

concept is also being applied to the search for new dual-purpose agents having enhanced percutaneous and inhalation effectiveness and in the design of extended-range artillery projectiles, rocket warheads, and aerial-delivered munitions. A continuous effort is being made in the search for new intermediate volatility incapacitating agents which are effective by both inhalation and absorption through the skin. Based on an assessment of the expected threat, a high urgency was placed on the development of new multispectral large-area smoke/obscurant systems. A five-year program was initiated in FY 1976 and FY 197T. All US standard smoke formulations and numerous foreign formulations have been characterized for their screening capabilities. The search for and testing and evaluation of new candidate materials are continuous efforts. Field characterization and evaluation of candidate materials is accomplished during an annually scheduled Smoke Week where both electro-optical devices and smoke/obscurant systems are employed in a simulated realistic battlefield environment. Smoke programs utilize approximately 75 percent of the dollars allocated to the Program Element. Accomplishments during FY 1979 include: (1) completed exploratory development on the man portable large-area screening system, (2) continued development on two infrared screening agents which showed good potential in Smoke Week II, (3) demonstrated that the approved training agent polyethylene glycol 200 will produce a good smoke screen in the large-area screening system, (4) characterized several candidate obscurants, and battle-induced dust for spectral attenuation properties, particle size distribution and chemical composition, (5) added methodology for munitions expenditure requirements to the Smoke Obscuration Model, (6) completed construction of full-scale 8-inch projectile reactant chamber and conducted tests to evaluate reaction kinetics, temperature, and stoichiometry of binary reactions. Results of the chamber tests helped resolve the cause of malfunctions of simulant-filled XM736 binary projectiles.

2. (U) FY 1980 Program: Complete technology support for XM736 Binary VX projectile and provide technical support to other munitions development; determine scale-up to munition parameters for selected intermediate volatility, or highly persistent agent for weaponization purposes; continue investigation of concepts for bulk-mixing techniques and mobile munitions; evaluate new drone system as a delivery vehicle; 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. Develop new concepts for smoke/obscurant agents, dissemination devices, and delivery means and establish a data base on obscurants and their effects. The chemical efforts will significantly enlarge the technology base required for modernization and expansion of the US deterrent/retaliatory chemical munition stockpile if such action is dictated by the threat. The binary concept will produce munitions with enhanced safety in handling, storage and employment. The smoke efforts will provide the technology base for development of obscurant systems that will enhance the survivability of troops and major weapon systems against enemy electro-optical and thermal sighting devices.

3. (U) FY 1981 Planned Program: Evaluate potential dual-purpose (inhalation and skin penetration) chemical agents with emphasis on their adaptability to the binary mode for several candidate munition systems (e.g., missile and rocket warheads,

Program Element: #6.26.22.A Title: Chemical Munitions and Chemical Combat Support
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

drones, and modular munitions); continue to search for safe reactive simulants for binary agents and practical means for field assessment of these simulants for use in lieu of open-air agent testing; continue search for improved multispectral screening compounds and compatible dissemination systems; continue smoke aerosol characterization studies; complete concept formulaton for improved infrared (IR) screening munitions and initiate concept studies for battlefield smoke elimination; complete toxicity effort (literature search, and preliminary, acute, and subchronic toxity evaluations) for candidate smokes; complete evaluation of Agent EA4923 for potential civil disturbance and tactical irritant use; continue studies of Agent EA3834 to determine its effectiveness as a percutaneous incapacitating agent. Develop new and improved methods and models for estimating the probability of incapacitating trauma from penetrating and blunt impacts. The program employs a total of 77 personnel: 65 professional and 12 support.

4. (U) FY 1982 Planned Program: Continue evaluation of potential dual-purpose lethal agents adaptable to the binary mode; complete exploratory development of lightweight mobile binary lethal agent system; continue evaluation of chemical agent manufacture process and reactive simulants; conduct solvent agent optimizing studies for incapacitating agent EA3834; continue development of the technical data base on candidate smokes with emphasis on environmental effects and development of optical characteristics and elimination techniques for smokes; continue smoke toxicity studies and weaponization studies for incapacitating and civil disturbance agents. Continue to develop new and improved methods and models for estimating the probability of incapacitating trauma from penetrating and blunt impacts.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.01.A
OD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Communication/Technology
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5108	5185	9985	9585	Continuing	Not Applicable
AH92-01	System Spectrum & Engineering for C^3	950	1000	3000	2000	Continuing	Not Applicable
AH92-02	EMC Technology	273	250	467	500		
AH92-03	Communication System Design Center	0	0	435	785	Continuing	Not Applicable
AH92-04	Signal Processing Technology	1215	1350	1638	1809	Continuing	Not Applicable
AH92-05	Multichannel Communications Technology	2286	2300	2500	2621	Continuing	Not Applicable
AH92-06	Tactical Net Radio Communications	384	300	650	785	Continuing	Not Applicable
AH92-07	Switching Technology	--	--	250	500		
AH92-08	Terminal Devices	--	--	200	500	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports development of the communications-electronics (CE) technology base required to meet the mission needs of the next generation of tactical communications systems. The evolving weapons and fire control systems require communication capabilities which the current inventory of communications-electronics cannot provide. The heavy emphasis on digital and mixed analog/digital data in these systems creates serious problems in the areas of information distribution, signal processing, electromagnetic compatibility (EMC), signal quality, propagation, spectrum management and system interoperability. Only the application of new technologies such as fiber optics, millimeter-wave, and Very High Speed Integrated circuits (VHSIC) will begin to solve these problems.

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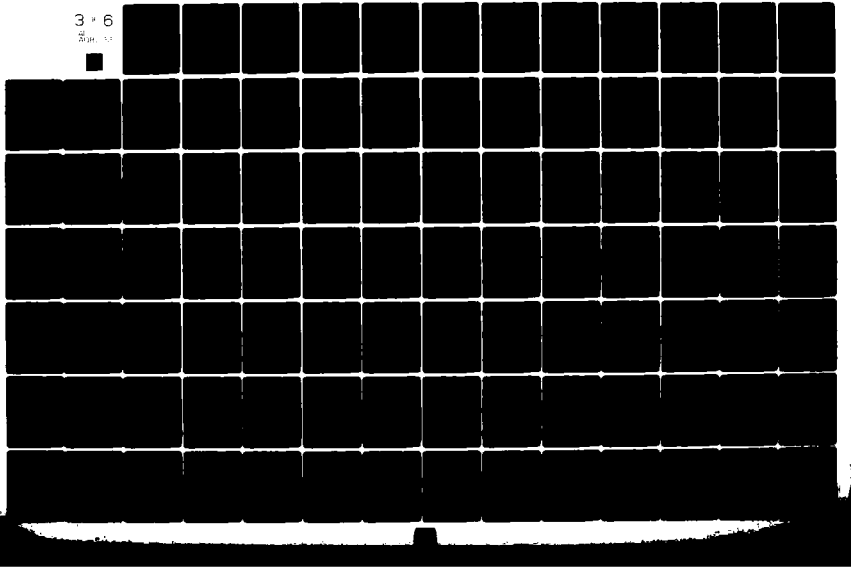

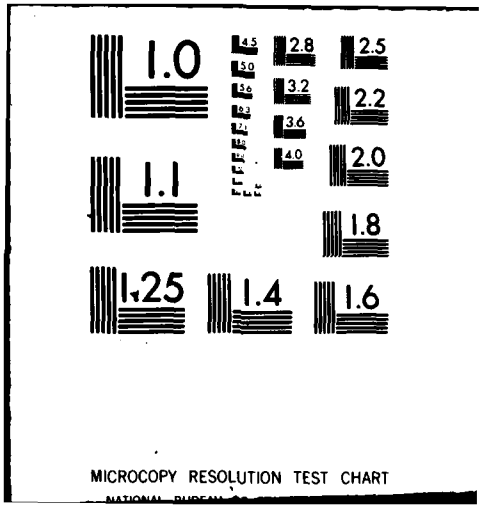
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MICROCOPY RESOLUTION TEST CHART

Program Element: #6.27.01.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Communication/Technology
Budget Activity: #1 - Technology Base

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Demonstrate Battlefield Information Distribution (BID) System extension to Brigade Forward communications using Very High Frequency-Frequency Modulated (VHF-FM) net radios. Fabricate and deliver improved high-strength optical fibers with water-impervious coatings (under a coordinated Navy program). Pursue a coordinated, phased incorporation of all local Communications Research and Development Command (CORADCOM) communications resources into the communications systems design center. Explore use of micropocessor-controlled look-up tables for realtime propagation/predictive information vital to High Frequency (HF) radio operation. Analyze and redefine all functions required at the central core of large Integrated Tactical Communications System (INTACS) communications nodes using the AN/TTC-39 circuit switch. Start contract to investigate bandwidth compression technique for facsimile. Complete the EMC 40-300 GHz measurement test and instrumentation (MT&I) requirements contract and decide need for follow-on hardware.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5108	5200	9940	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	7257*	13291*	13502	Continuing	Not Applicable

(U) The FY 1981 budget reflects a redirection which withdraws the Tactical ADP Technology and Communicative Technology areas, placing them under a different program element and project number (6.27.46.A/A094). The remaining portion of AH92 actually undergoes a nominal increase which reflects start of three new areas (Terminal Devices Switching Technology and Communication System Design Center) with most of the increase in FY81 due to the transfer of $1.440M from P.E./Project 6.27.46/A094 in order to consolidate funding for systems engineering in one Program Element and an expanded effort in the area of spectrum optimization in order to resolve the increased problem of frequency management that has developed as new and more sophisticated communication systems are fielded.

Program Element: #6.27.01.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Communication/Technology
Budget Activity: #1 - Technology Base

*FY 1979 and FY 1980 Total Includes the ADP and Communicative Technology Area now funded in P.E./Project 6.27.46.A/A094-FY79 level reflects an increase of 825K to fund an interoperability evaluation of the Short Range Air Defense Systems (SHORAD) communication system and a progagation analysis of the Battlefield Information Distribution (BID) system. The FY80 level reflects the $10.5M (including ADP) lid placed upon this program by Congress.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.01.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Communication/Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Automation and Communication are rapidly becoming significant facets of almost every Army Defense System. The project goal is to provide technologies that will reduce the cost of development and support of tactical automation and communication functions and to accelerate the fielding and improve the survivability of all Army systems in which automation and communication play major roles. Present communications technology does not meet today's Army needs. Problems of excess weight, size, power drain, crosstalk, Electromagnetic Pulse (EMP) and Electronic-Countermeasures (ECM) threat, reliability, and low channel capacity require application of advanced technology. The approach to solving these problems is to develop new methods and techniques needed for future Army Communication-electronic (C-E) systems and requires exploration of the following: fiber optic and Millimeter Wave (MMW) communication; EM wave generation, amplification, and modulation for line of sight and troposcatter; techniques for handling, multiplexing, and storing information; electromagnetic compatibility; system technology, net communications to exploit the latest state of the art with emphasis on antennas and HF communications; packet radio and related technologies for the evolving Army Digital Distribution System (ADDS); switching technology; spectrum optimization; and information acquisition and processing (speech, print, picture).

G. (U) RELATED ACTIVITIES: This program provides the exploratory development needed to support the following: Program Element 6.37.07.A, Tactical Communications Development; Program Element 6.37.22.A, Tactical Operations System; Program Element 2.80.10.A, Joint Communications Program, (TRI-TAC); 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 and avoidance of duplication is accomplished by reviews conducted by Department of Defense, through the exchange of technical reports and attendance at scientific meetings and conferences. Program element 6.11.02.A, Defense Research Sciences provides the basic research support for project AH92. Cooperation is conducted with DARPA/TRADOC/and XVIII Airborne Corps for concept formulation of an Army Battlefield Information Distribution System (BID) using packet radio technology.

H. (U) WORK PERFORMED BY: Atlantic Research Corp. Alexandria, Va; SRI International, Menlo Park, CA; MITRE Corp., McLean, VA. Twenty-five other contracts will be awarded during FY 1981 with a total value of $6,730,000. In-house developing organizations are US Army Communications R&D Command (CORADCOM), Ft. Monmouth, New Jersey; and DOD Electromagnetic Compatibility Analysis Center (ECAC), Annapolis, MD.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Completed the design and evaluation of an instrumentation system to evaluate electromagnetic susceptibility of C-E items. Provided Electromagnetic Compatibility (EMC) guidance to various Project

Program Element: #6.27.01.A
Title: Communication/Technology
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)
Budget Activity: #1 - Technology Base

Managers (PM's). Assumed responsibility for Army spectrum optimization and frequency allocation, and coordinated Army support for all international study groups and WARC-79. Started a propagation loss measurement/data collection methodology effort in electromagnetic compatibility (EMC) and completed 80 percent of it. Started operation of Battlefield Information Distribution (BID)/Packet Radio corps level testbed activity in garrison (Ft. Bragg). Procured 27 packet radios, associated hardware and fabricated communication interfaces for TACFIRE system components. Demonstrated packet radio system operation at the Fourth Battlefield Automation Appraisal (BAA IV) June 1979. Completed qualification tests for Long Haul Fiber Optic (F.O.) Communications System, which is now ready for engineering development. Completed first phase of Secure F. O. Cable System. The scale model of the phased array antenna amplifier (microwave) was completed and tested. Completed design for development of 55 GHz omnidirectional and binocular radios for tanks. Started HF communications effort with preparations to award contract which will develop long-range plans for this effort.

2. (U) FY 1980 Program: Start work to determine Electromagnetic Compatibility (EMC) Measurement Test & Instrumentation (MT&I) requirements in the 40-300 GHz range. Continue EMC guidance to project managers. Integrate packet radios into the Battlefield Information Distribution (BID) corps level testbed for field/mobile operation. Start contracts for additional user system/BID interface/integrations to investigate propagation characteristics of spread spectrum systems such as packet radios and EMC aspects of BID. Models of militarized Fiber Optic (F.O.) connectors and a splice and repair kit will be delivered and tested. Evaluation of prototype F.O. connectors will result in selection of those most favorable for tactical F.O. systems. The missile payout F.O. system will move into advance development with the completion of rocket sled testing. Complete the contract for expendable/air-layable F.O. cable, evaluate operational tests with its application to manpack deployment assessed. A secure F.O. cable system will be delivered for testing. Start a new thrust to develop F.O. multiple access/distributed multiplexing. Complete the foliage penetration test at 30 and 60 GHz for Multimeter Wave (MMW) radios and Europe tests on MMW command post radios (CPR). Start contracts for mechnically tuned MMW radios (54 to 58 GHz). Develop and test modular omnidirectional/binocular MMW radios for tank applications at Ft. Knox. Start adaptive techniques contracts for line-of-sight microwave radios. Prepare specifications and award for theoretical/experimental investigations of new tactical antennas, advanced multicouplers and tuning techniques based upon results of the FY79 basic research (6.1) antenna effort. Complete the High Frequency (HF) communications development plan and start contracts for experimental investigations in adaptive signal processing, modems or digital message devices for HF radio. Develop Automated Battlefield Spectrum Management Pilot System deployment for NATO environment. Start Systems Engineering Integration effort with concept objectives for long-term operation.

3. (U) FY 1981 Planned Program: Complete the 40-300 GHz EMC Measurement Test & Instrumentation (MT&I) requirements contract and decide need for follow-up development of exploratory hardware/components. Continue EMC guidance to project

Program Element: #6.27.01.A Title: Communication/Technology
DOD Mission Area: #521 - Electronics & Physical Sciences (ED) Budget Activity: #1 - Technology Base

managers and frequency optimization support. Develop the design plan to coordinate phased incorporation of all U.S. Army Communications R&D Command's (CORADCOM) communications resources into the communications systems design center including all equipment for which the command has life cycle support responsibility. Prepare a contract to plan provision for an intersystem capability which will tie the communications systems design center directly into the US Army Europe (USAREUR) community, Defense Communications Agency (DCA), NATO, TRITAC testbed, and other designated DOD and commercial communications and data systems. Communications equipment will be purchased for the transmission testbed portion of the design center. Demonstrate Battlefield Information Distribution System (BID) extension to BRIGADE FORWARD using Very High Frequency- Frequency Modulated (VHF-FM) net radios. Continue support of the Packet Radio/BID testbed. Develop secure network concepts for packet radio in coordination with National Security Agency (NSA). Start investigation of multichannel/satellite communications to interconnect data distribution networks. Evaluate EMC and propagation characteristics of spread spectrum systems. Fabricate improved high-strength optical fibers with water-impervious coating under a coordinated Navy program. Complete the splicing method and associated tooling effort for Fiber Optic (F.O.) cable. Test the longer wavelength sources and detectors for possible retrofit in the long haul F.O. cable system. Establish the structure of the F.O. multiple access system as compatible with the TRI-TAC family of equipment. Develop tunable omnidirectional Millimeter Wave (MMW) 54-58 GHz radios for tank-to-tank communications. Complete the microwave radio adaptive techniques contracts. Expand the antenna effort to more thoroughly assess emerging technology potential. Consider use of microprocessor-controlled look-up propagation tables for High Frequency (HF) radio operation. Start work in Switching Technology with analysis of control functions required at the central core of a large Integrated Tactical Communications System (INTACS) communications node. Start work in Terminal Devices Area with contract to investigate bandwidth compression techniques for facsimile. Continue Spectrum Management Pilot System deployment and apply approaches for combat-effective use of the frequency spectrum to immediate problem bands (VHF-UHF) and evaluate options. Refine and translate system integration objectives and translate them into specific technical requirements. Complete the Army Command and Control System (ACCS) top level specification for the Army Command and Control Master Plan (AC^2MP), continue to develop and maintain the required interoperability documents, and intensify interface standardization efforts in the intraservice, joint, national, and international arena. The number of personnel involved during this year is 50 (40 professional, 10 support).

4. (U) FY 1982 Planned Program: Develop frequency optimization and dynamic Electromagnetic Compatibility (EMC) analysis models. Start contract to install system control, monitoring and interconnection facility and complete the plan to integrate all local CORADCOM communications resources into the comm systems design center. Include secure-like operation in the Packet Radio/BID testbed deployment. Start effort to apply state of the art advances in signal processing to Electronic-Counter-Countermeasures/Low Probability of Intercept (ECCM/LPI) communications, integrated coding/modulation techniques and high time-bandwidth product signal detection. Start component development to field a multiple access data

Program Element: #6.27.01.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Communication/Technology
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bus system. Field test tunable 60 GHz omnidirectional radio, and start contracts to develop low-cost, compact MMW repeaters for Command Post Radio (CPR) range extension, solid state high-power microwave amplifiers and techniques for modern digital microwave radios. Transfer promising parts of tactical antenna and HF communication into advanced development. Select bandwidth compression techniques and begin fabrication of an 8-inch scanning head for facsimile. Continue VHSIC contract with emphasis on fabrication and integration of phase I modules into the complete systems. Expand the capabilities of the Automated Battlefield Spectrum Management and Engineering Pilot Systems in Europe and XVIII Airborne Corps towards inclusion of pseudo-noise and frequency hopping spread spectrum communications, avionics, and radars and interoperability with automated command and intelligence/Electronic Warfare Systems.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.03.A

Title: Combat Surveillance, Target Acquisition and Identification

DOD Mission Area: #521 - Electronics and Physical Science (ED)

Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5213	3615	4420	4994	Continuing	Not Applicable
DH93	Combat Surveillance, Target Acquisition and Identification	5213	3615	4420	4994	Continuing	Not Applicable

B. (U) 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 componentry to reduce size and cost, and to increase performance and reliability; non-cooperative battlefield identification friend or foe; radar techniques to identify stationary and moving targets, penetrate foliage, and provide an all-weather capability; passive acoustic techniques to rapidly locate hostile artillery; and integrating surveillance and target acquisition sensors to provide fused output. It also 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: personnel and vehicle detection; identification; data transmission; weapons location; detection and measurement of nuclear radiation and bursts; and the integration of surveillance and target acquisition sensors.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Results of ongoing efforts to develop lightweight, modular componentry amenable to low cost quantity production will be integrated into a test bed radar system and field tests conducted. Work will be performed on stationary and moving target detection and identification; non-cooperative battlefield identification; multi-static radar; electronically steerable multiple beam antenna technology for intelligence, surveillance, and target acquisition sensor data transmission; and an automated linear base acoustic weapons locating system. Operational concepts for netting of radar sensors will be explored in a Force Development Test and Evaluation which will extend into FY 1982. Testing of low-cost prototype radiation dosimeters and radiacmeters will continue.

Program Element: #6.27.03.A

Title: Combat Surveillance, Target Acquisition and Identification

DOD Mission Area: #521 - Electronics and Physical Science (ED)

Budget Activity: #1 - Technology Base

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (Current Requirements)	5213	3615	4420	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	5239	3658	4435	Continuing	Not Applicable

The FY 1980 decrease is the result of a general Congressional reduction. FY 1979 and 1981 decreases reflect minor adjustments consistent with Army priorities.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.03.A

Title: Combat Surveillance, Target Acquisition and Identification

DOD Mission Area: #521 - Electronics and Physical Science (ED)

Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This project funds the exploratory development performed by the Combat Surveillance and Target Acquisition Laboratory. Major areas are weapons location technology with emphasis on a passive, automated, linear base, acoustic, artillery target location system to replace the current manual system; investigations of sensor data transmission with the objective of reducing vulnerability to detection and jamming, reducing radio frequency spectrum requirements, eliminating relays, and reducing size, weight, and cost; development of radar techniques for the detection, classification, and identification of stationary nonfiring targets under all visibility conditions; development of radar techniques for the classification and identification of moving targets under all visibility conditions; development of lightweight, low-cost, common radar modules amenable to quantity production which will lower life cycle costs of future radar systems due to commonality in logistics, maintenance, and training requirements; development of a low-cost, multipurpose, tactical radiation measurement device which will perform the functions presently requiring several separate devices; investigation of non-cooperative battlefield identification friend or foe; and development of multistatic radar technology to enhance sensor coverage and survivability on the battlefield.

G. (U) 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 interlaboratory visits and communications, attendance at specialized scientific meetings and conferences, inter-Service liaison, technical reports, and the Annual Tri-Service Radar Symposium. Additionally, the Army and the Defense Advanced Research Projects Agency (DARPA) are participating in a joint program to be completed to be completed in FY 1980 to find new or improved solutions in the radar netting area under Program Element 6.27.26.A., Army Support of DARPA.

H. (U) WORK PERFORMED BY: In-house work is performed by the US Army Electronics Research and Development Command at Fort Monmouth, NJ, and at Adelphi, MD. Contractors include Harris Corporation, Melbourne, FL; Texas Instruments, Dallas, TX; Georgia Institute of Technology, Atlanta, GA; RCA, Princeton, NJ; Hughes Aircraft Company, Culver City, CA; Motorola, Scottsdale, AZ; AIL Division Cutler Hammer, Long Island, NY; Malibu Research Associates, Santa Monica, CA; Harshaw Chemical, Cleveland, OH; and Oak Ridge National Laboratory, Oak Ridge, TN.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Prior technological efforts have resulted in or contributed to type classification and procurement of the AN/PPS-5, AN/PPS-15, AN/TPQ-36, and AN/TPQ-37 radars; eminent initiation of advanced development of the Surveillance and Target Acquisition Radar for Tank Location and Engagement, and full-scale development of

Program Element: #6.27.03.A

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the Modular Integrated Communications and Navigation System. During FY 1979, the feasibility of a lightweight, low-cost, gallium arsenide Ku band radar transmitter/receiver with high transmitter power conversion efficiency was demonstrated. Tests of the Antiarmor Surveillance and Target Acquisition Radar (ASTAR) were successfully conducted. During these tests the capability of ASTAR to simultaneously track multiple targets, adjust artillery fire, and handover targets to a simulated anti-armor weapon system was demonstrated. Evaluation of previously delivered Charge Coupled Device radar signal processors was continued. Stationary target detection and classification techniques previously investigated were successfuly demonstrated with actual military targets in clutter and the classification capability was expanded to three classes. An ultra-low side lobe Ku band radar antenna using a low-cost, tilted-beam antenna concept was successfully fabricated and demonstrated. Study of a tactical multistatic radar system utilizing distributed transmitters and receivers was initiated. An experimental phase-locked phaseshifter which possesses stable linear performance over a +600-degree range and an octave bandwidth (7 to 15 GHz) was fabricated and tested. Development of a digital, constant bandwidth compression unit was continued. An effort to define the parameters for a totally automated, passive, acoustic weapons location system was initiated. Technology required to draw optical fibers from lithium fluoride crystals for use in a low-cost, optical fiber dosimeter was successfullly demonstrated. Evaluation of cadmium telluride as a radiation detector was continued.

2. (U) FY 1980 Program: Continue technological support to ongoing developmental programs. A previously developed filter bank Charge Coupled Device radar signal processor, a prototype tilted-beam antenna and the previously developed gallium arsenide Ku band radar transmitter/receiver, modified to provide frequency agility, will be integrated into the Antiarmor Surveillance and Target Acquisition Radar. The system concept and signal processing requirements for a tactical multistatic radar system will be defined. Tests of the sideband, fast frequency hop transmitter/receiver will be conducted to demonstrate the ability to transmit data via remotely piloted vehicle relay beyond line of sight in an electronic countermeasures environment. Computer algorithms which allow bandwidth compression in the transmission of video data to achieve anti-jam protection without significantly degrading performance will be demonstrated. The acoustic data base required for modeling of a totally automated passive acoustic weapons locating system will be collected and parameters of the baseline system defined. The scope of earlier stationary classification work will be expanded by testing and refining algorithms for multiple-target cases and for targets in clutter. Techniques leading to classifier embodiments of minimum complexity and capable of acting in near real time will be developed. Pattern recognition techniques will be applied to the analysis of previously collected radar doppler frequency signatures to evaluate the feasibility of noncooperative identification. Fiber coils of lithium fluoride will be fabricated as a prompt gamma radiation total dose sensor. A beta and gamma radiation dose rate sensor of cadmium telluride will be fabricated and evaluated as a replacement for much larger and more costly Geiger-Mueller tubes. A new effort to permit identification and location of enemy nuclear munitions on the battlefield will be initiated.

Program Element: #6.27.03.A

Title: Combat Surveillance, Target Acquisition and Identification

DOD Mission Area: #521 - Electronics and Physical Science (ED)

Budget Activity: #1 - Technology Base

3. (U) FY 1981 Planned Program: Continuation of the FY 1980 program. Extensive field testing of the Antiarmor Surveillance and Target Acquisition Radar test bed with a frequency agile gallium arsenide transmitter/receiver, tilted beam antenna and Charge Coupled Device radar signal processor will be conducted to refine technology applicable to development of any future Army ground surveillance radar. Radar netting technology will be exploited during testing to explore and refine operational concepts for netted sensors. Investigation of tactical multistatic radar will continue. Stationary target detection and classification efforts will be continued and the most promising classifier selected. The application of stationary target detection and classification techniques to noncooperative identification friend or foe will be investigated. To support sensor data transmission, development of a matched filter array processor and of a one-watt monolithic octave bandwidth power amplifier for use in a multibeam antenna system will be initiated. Continue development of the automated acoustic weapons location system signal detection and recognition capability, initiate hardware fabrication, and define parameters for a state-of-the-art surface acoustic wave array processor to support system advanced development. Integration of a lithium fluoride fiber radiation total dose sensor and a cadmium telluride radiation dose rate sensor into a miniature, multipurpose radiac device will be initiated. Continue effort to provide a capability to identify and locate nuclear munitions on the battlefield. A total of 21 professional and 5 support personnel are involved in this program element.

4. (U) FY 1982 Planned Program: Continuation of the FY 1981 program. Continue efforts on stationary target detection and classification, noncooperative battlefield identification friend or foe, common radar modules, and tactical multistatic radar. Complete testing to explore and refine operational concepts for netted radar sensors. Transfer stationary target classifier technology to Stand Off Target Acquisition System. Identify the most promising stationary target classifier embodiment for the remotely piloted vehicle and the Surveillance and Target Acquisition Radar for Tank Location and Engagement. Continue development of the matched filter array processor and monolithic octave bandwidth power amplifier. Initiate development of a programmable modem to provide compatibility between the Modular Integrated Communications and Navigation System data link and other sensor data links. Continue effort on miniature, multipurpose radiac device. Continue effort to provide a capability to identify and locate enemy nuclear munitions on the battlefield.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.04.A
DOD Mission Area: #522 - Environment and Life Sciences

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

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2950	3556	3906	3798	Continuing	Not Applicable
AF25-01	Analytical Systems Technology	545	922	762	771	Continuing	Not Applicable
AF25-02	Standards Development	409	584	761	912	Continuing	Not Applicable
AF25-03	Decontamination Technology	1996	2050	2383	2115	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program was established in FY 1977 to provide exploratory development of new technology in support of the Project Manager for Chemical Demilitarization and Installation Restoration. The current priority emphasis of the program is directed toward supporting prevention of contamination migration from the Rocky Mountain Arsenal (RMA), Denver, CO and providing technology support to the decontamination of installations declared excess to military needs. The technical thrusts of the program are: development of analytical techniques for identification and quantification of contaminants; research to characterize contaminants, determine their toxicities and provide data for the establishment of realistic environmental levels; 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. (U) BASIS FOR FY 1981 RDTE REQUEST: To develop analytical methodology for identification and quantification of contaminants found in soil, water, process disposal facilities, and biological tissues in support of contamination surveys scheduled at five Army installations; to perform hazard analyses, toxicity screens and toxicological studies for development of environmental levels for contaminants moving across Army installation boundaries or existing at facilities scheduled for excessing action; to develop soil and water treatment processes to eliminate or reduce the concentration of contaminants to environmentally acceptable levels; and to develop techniques to decontaminate facilities and equipment which are excess to Army needs.

Program Element: #6.27.04.A
DOD Mission Area: #522 - Environment and Life Sciences

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

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Costs
RDTE					
Funds (Current Requirements)	2950	3556	3906	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	3307	3559	4099	Continuing	Not Applicable

The $357K decrease in FY 1979 funds from the FY 1980 submission and the $193K decrease in FY 1981 funds over the FY 1980 submission result from reprogramming to higher priority projects. The FY 80 decrease is the result of a general congressional reduction.

E. (U) OTHER APPROPRIATION FUND: Not applicable

Program Element: #6.27.04.A
Title: Military Environmental Criteria Development
DOD Mission Area: #522 - Environment and Life Sciences
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Increasing public concern 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 movement of groundwater contaminants to the borders of the installations and beyond. As a result of military, Congressional and public interest in such contamination at Rocky Mountain Arsenal (RMA), direction was provided by the Assistant Secretary of the Army for Installations, Logistic and Financial Management (ASA(I,L&FM)) to establish a comprehensive program for correcting the total Army problem. Responsibility for this program was assigned to the Project Manager for Chemical Demilitarization and Installation Restoration (PM CDIR) and a charter was approved by the Secretary of the Army on 22 August 1975. Effective 1 October 1978 PM CDIR was redesignated the US Army Toxic and Hazardous Materials Agency (USATHAMA). An overall plan of approach to the problem was developed which involves three principal phases, namely; Installation Assessment, Technical Systems Development and Decontamination Operations. The RDTE funded part of this plan applies primarily to the the Technical Systems Development phase. The other phases of the plan will be accomplished with Operation and Maintenance, Army (OMA) and Military Construction, Army (MCA) appropriations. The technology effort consists of three 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. In addition, effort is directed toward establishing acceptable environmental levels for concentrations of pollutants by performing chemical and toxicological studies for Army peculiar pollutants when such levels are not available. Further, evaluation of existing technology and development of new technology is being performed as necessary to control migration of pollutants, provide analytical methods and decontamination techniques to support these efforts.

G. (U) RELATED ACTIVITIES: Conduct of the Installation Restoration (IR) Program and efforts to preclude duplication of effort involves extensive interface with a significant number of other Government agencies. These include, 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) Explosives 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 mission is the assigned responsibility of USATHAMA.

H. (U) WORK PERFORMED BY: In FY 1981 aproximately 18% of the funding will be assigned to the US Army Medical Bioengineering Research & Development Laboratory, Ft Detrick, Frederick, MD, for toxicology testing of chemical contaminants leading to the establishment of environmental levels. Aproximately 18% of the dollars will be assigned to Chemical Systems Laboratory, Product Assurance Directorate, and the US Army Armament Research and Development Command, APG, MD for contractual efforts to assist in developing advanced techniques for sampling, analyzing, handling and storing contaminated samples. The balance of the RDTE program resources (64%) will be used for development of decontamination process technology. It is estimated that aproximately 70%

Program Element: #6.27.04.A Title: Military Environmental Criteria Development
DOD Mission Area: #522 - Environment and Life Sciences Budget Activity: #1 - Technology Base

of the total program in FY 1981 will be in contracts; 3% will be assigned to Government agencies outside the Army and 27% will be used for in-house efforts. Principal current contractors include: Calgon, Pittsburg, PA; Arthur D. Little, Boston, MA.; and Stanford Research Institute, Palo Alto, CA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: This Program Element was established in FY 1977 to prevent hazards to the public health and safety from contamination migrating off DOD Installations to surrounding communities and from release of previously contaminated property to the public. The program is divided into three areas of emphasis (a) Analytical Systems (development of methods to determine levels of trace contaminants in soil and water); (b) Standards Development (determine environmentally safe levels of chemical contaminants in the environment); (c) Decontamination Technology (develop systems to contain, reduce or eliminate contamination). From FY 1977 through FY 1979 accomplishments in each of these technical areas are described as follows:

(a) (U) Analytical Systems: Qualitative analytical techniques were developed to quickly screen contaminated waters to establish a baseline of compounds present on an installation. These techniques include Gas Chromatograph/Mass Spectrometry and High Pressure Liquid Chromatography. Valid quantitative analytical methods were developed at the low detection levels required by Environmental Standards to the part per trillion range. Twenty-four of these methods were developed during the period. A Quality Control Manual was published and implemented to ensure consistency and reliability of data from various in-house and contractor laboratories. Finally, "Standard Analytical Reference Materials" traceable to the National Bureau of Standards were developed for each contaminant of concern.

(b) (U) Standards Development: Environmental levels do not exist for many contaminants found during installation surveys. The Army Surgeon General has been tasked to screen these contaminants in a problem definition study and select specific contaminant compounds for toxicological studies from which environmental levels can be recommended to the Regulatory Agencies. Problem definition studies have been performed on 45 contaminants and follow-on toxicity work was conducted on five of the compounds found at Rocky Mountain Arsenal. Environmental levels have been recommended for all five compounds.

(c) (U) Decontamination Technology: This technical area involves the development of water and soil treatment processes for large areas, secondary waste elimination, subsurface water management techniques and control of contaminant transport phenomenon. During the period, a pilot containment/treatment system was installed and operated at Rocky Mountain Arsenal (RMA). This system consists of a series of dewatering wells, a 1500 ft bentonite clay barrier anchored into an impermeable strata some 23 ft below the surface, a granular carbon adsorption system and a series of recharge wells. Contaminated groundwater is removed from the aquifer, treated and then reinjected into the aquifer downstream of the barrier. This system has successfully processed over 20 million gallons of contaminated groundwater since installation. Design criteria was also developed for a system to

Program Element: #6.27.04.A
DOD Mission Area: #522 - Environment and Life Sciences

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

isolate the sources of contamination at Rocky Mountain Asenal (RMA). Water treatment studies were performed involving both organic and inorganic removal techniques. Granular carbon adsorption and ultraviolet ozonolyis processes were tested using waters at the sources of contamination at Rocky Mountain Arsenal (RMA). Studies were performed on methods to remove fluoride from groundwater in support of the pilot containment/treatment system at Rocky Mountain Arsenal (RMA).

2. (U) FY 1980 Planned Program: Increased effort is being directed toward the development of analytical methods for the identification and quantification of approximately 18 chemical compounds found in the soil, water, process waste disposal facilities and biological tissues of organisms at nine Army installations scheduled for contamination surveys. Methods for extraction and preservation of samples, as well as the development of standard analytical reference materials for use in laboratory quality control and measurement are being developed. In the Standards Development area, problem definition studies, toxicity screening and follow-on toxicity studies are being performed on chemical compounds found in the soil, water, process waste disposal facilities and biological tissues at the Army instalations undergoing contamination surveys. Additionally, 18 candidate compounds are undergoing hazard analysis; three toxicity screens and one full-scale toxicity study, using vegetation, mammals, wildlife, domestic and aquatic animals, are in progress. Long-term containment material compatibility studies are in progress in support of Rocky Mountain Arsenal (RMA). Alternative techniques to granular activated carbon for removal of DDT are being investigated. Studies of enhanced leaching of migrating contaminants and soil treatment of less mobile pollutants have been initiated for possible cleanup of active sources. Techniques that apply in-situ and excavated processing, such as soil activation, chemical fixation and chemical neutralization/vegetative uptake, are being screened for applicability. Methods for decontaminating buildings and equipment are under evaluation. Water treatment systems are being developed to remove suspended solids, organics, inoganic salts and metals. The thrust of this development effort is to integrate the different treatment systems so that treatment trains can be devised to handle heterogenous liquid waste.

3. (U) FY 1981 Planned Program: Analytical methods will be developed for identification and quantification of approximately twelve additional chemical compounds found in soil, water, process waste disposal facilities, and biological tissue of organisms from five Army installations scheduled for contamination surveys. In addition, development of analytical methodology for detection and quantitative analysis of degradation and process by-products from developmental decontamination processes will be initiated. In the area of Standards Development, problem definition studies, toxicity screening and follow-up toxicity studies will be continued on chemical compounds found in soil, water, process waste disposal facilities and biological tissues. Some twelve new compounds will undergo hazard analysis, four toxicity screens, and two full-scale toxicity studies using vegetation, mammals, wildlife, domestic, and aquatic animals. In the area of Decontamination Technology, long-term containment material compatibility studies will be completed for source isolation alternatives being considered at Rocky Mountain Arsenal (RMA). In conjunction with five contamination surveys scheduled for FY 1981, interim containment measures will be refined and implemented in a pilot system design to stop off-post migration. Concurrent with the RMA expanded containment system process improvement, other treatment improvements will be processed. Leaching and soil treatment technology development will be refined as the data base

resulting from the contamination surveys expands. Limited laboratory studies of in-situ containment/treatment techniques will be initiated. Water treatment studies will build upon technical data base from ongoing comprehensive surveys. Building and equipment decontamination techniques will be piloted. Methods will be developed to predict material compatability of barrier and liner materials. Containment and treatment systems will be piloted at two installations. Number of personnel supported with requested FY 81 funds: Professional 18, Support 2.

4. (U) FY 1982 Planned Program: Analytical methods will be developed for the identification and quantification of approximately eight chemical compounds found in soil, water, process waste disposal facilities and biological tissue from five Army installations scheduled for contamination surveys. Approximately eight compounds will undergo hazard analysis, three toxicity screens, and two full scale toxicity studies. Preliminary design criteria for final containment measures resulting from three environmental surveys will be finalized. Field and pilot water treatment studies will be conducted as input to the technology base development for contaminated installations. Development of techniques for fixation of explosive wastes in soils and waters will be completed. Development of a predictive model to estimate barrier and liner material compatability with wastes will be nearing completion.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.05.A
Title: Electronics and Electron Devices
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	13335	14619	14867	16728	Continuing	Not Applicable
AH94	Electronics and Electron Devices						
AH94 01	- Microwave Tubes and Subsystems	1483	1014	1120	1850	Continuing	Not Applicable
AH94 02	- Pulse Power Technology and Subsystems	860	1245	1220	1330	Continuing	Not Applicable
AH94 03	- Displays and Peripherals	750	739	779	840	Continuing	Not Applicable
AH94 04	- Integrated Electronics	1267	2395	2460	2400	Continuing	Not Applicable
AH94 05	- Cost Effective Microelectronic Modules	1212	1981	1960	2100	Continuing	Not Applicable
AH94 06	- Reliability	534	550	520	650	Continuing	Not Applicable
AH94 07	- Millimeter Wave Devices and Circuits	1096	1795	1800	2030	Continuing	Not Applicable
AH94 08	- Microwave Integrated Circuits	858	1362	1300	1530	Continuing	Not Applicable
AH94 09	- Acoustic Signal Processing Devices	933	920	940	990	Continuing	Not Applicable
AH94 10	- Frequency Control Devices	991	1000	900	1000	Continuing	Not Applicable
AH94 11	- Power Sources and Subsystems	1354	1719	1801	1860	Continuing	Not Applicable
AH94 13	- Advisory Group on Electron Devices (AGED)	234	0	0	0	Continuing	Not Applicable
AH94 14	- Very High Speed Integrated Circuits (VHSIC)	1842	0	0	0	Continuing	Not Applicable

Program Element: #6.27.05.A
Title: Electronics and Electron Devices
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)
Budget Activity: #1 - Technology Base

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This exploratory development program in electron devices and related materials technologies is resolving critical component barrier problems which are preventing performance, cost, size, weight, and reliability improvements in Army electronic equipment to meet specific enemy threats. This project will provide required increases in electron device performance; on this base, critical new and improved electronic systems concepts are being developed to provide the technological superiority of our forces. Specifically, the program encompasses the development of selected basic electronic building blocks which pace the development of approximately 50 Army systems concepts; included are integrated circuits, solid state devices, microwave tubes, power sources, millimeter components, frequency control, and display devices. These device developments are directly coupled to systems objectives in electronic warfare, night vision, communications, avionics, data processing, combat surveillance and target acquisition, guidance and fire control, navigation and position location, and missile technology.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: The FY81 program in electron devices is aimed at developing: compact, lightweight pulsers/modulators for millimeter wave radar on mobile tactical equipment for penetrating weather/smoke/obscurants and compact high energy density power conditioning units for directed energy weapons; low-cost millimeter-wave (MMW) Integrated Circuit (IC) receiver modules and solid state transmitter subsystems at 94, 140, and 220 GHz for Moving Target Indicator (MTI) radar; special tubes which will jam enemy microwave communications; wideband, low noise Gallium Arsenide (GaAs) integrated circuit (IC) receivers with the ability to locate and identify hostile transmissions over extended frequencies; signal processing technology for building Large Scale Integrated (LSI) modules to handle 1982 signal analysis and targeting threat; large bandwidth acousto-optic signal processing devices for large-scale deployment of highly sensitive interceptor and locator with ultra-fast response; high power primary lithium batteries to meet user demands (i.e., laser designators/rangefinders, Night Vision devices, etc.), and to replace high-power rechargeable batteries in critical forward area equipment and thus eliminate the need for battery recharging under field combat conditions; infrared (IR) sources operating at 3-5 um and 8-4 um for advanced IR jammers to be fielded in FY81; tactical displays for C^3 and Intelligence, Surveillance and Target Acquisition (ISTA) which will improve force mobility for manportable and mobile equipment; and miniature, low-cost, high precision, vibration resistant, fast-warmup quartz crystal oscillators to provide secure C^3, navigation and identification systems with antijam (AJ) capability in a mobile environment.

Program Element: #6.27.05.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

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

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	13335	14619	14867	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	13670	14720	16897	Continuing	Not Applicable

Funding differences between Congressional Descriptive Summaries submitted last year (1980) and this year (1981) are as follows:

1. (U) FY 1979: This reduct'on was due to minor reprogramming actions to satisfy urgent, high priority Army requirements.

2. (U) FY 1980 funding decreased due to a general reduction by Congress.

3. (U) FY 1981: This decrease was used to fund a portion of the Army's participation in the DOD Very High Speed Integrated Circuit (VHSIC) now carried under a centralized PE per Congressional direction.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: 6.27.05.A
DOD Mission Area: 521 - Electronics & Physical Sciences (ED)

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

F. (U) 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 superiority of our forces. The technological gap between the US and the Communist Bloc has been closing very rapidly over the past several years. It is imperative that the funding for this Program Element be increased in order to exploit new breakthroughs and restore our lead in key device technologies. In this respect, 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.

G. (U) RELATED ACTIVITIES: Coordination is achieved with other Government agencies through the Department of Defense (DOD) Advisory Group on Electron Devices (AGED) and the interagency Advanced Power Group to preclude any duplication of effort. Related PE 6.37.42.A, Advanced Electron Devices.

H. (U) WORK PERFORMED BY: The Electronics Technology and Devices Laboratory (ET+DL), Fort Monmouth, New Jersey. This Army laboratory is scheduled to use approximately 50% of the program funds contractually. Principal contractors are: P. R. Mallory, Burlington, MA; Watkins-Johnson, Palo Alto, CA; Radio Corporation of America, (RCA), Burlington, MA; Somerville, Camden, Princeton, NJ; TRW, Redondo Beach, CA; Hughes Aircraft Co., Fullerton and Torrance, CA; Northrop, Roll Meade, IL; EG&G, Salem, MA; Raytheon, Waltham, MA; Rockwell International, Anaheim, CA; Westinghouse, Pittsburgh, PA; Motorola, Scottsdale, AZ; Power Electronics Association, Lincoln, MA; Honeywell, St. Petersburg, FL; Electro Mag Se, Atlanta, GA; ILC Technology, Sunnyvale, CA; and Texas Instruments, Dallas TX.

Program Element: #6.27.05.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

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

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: In FY 1979, the ET&DL was very successful in developing critically needed electronic devices which will improve the Army's capability to see, fight, and communicate on the battlefield in the following thrust areas:

a. (U) Microelectronic Devices - A second-generation programmable digital-to-video converter was developed in-house for Nap-of-the-Earth Helicopter equipment using the latest Large-Scale Integration (LSI), Medium-Scale Integration (MSI), and hybrid microcircuit technology. A 10X reduction in the cost of design and layout of integrated circuits was effected by development of two new unique Computer-Aided Design (CAD) programs by optimizing geometric designs for military equipment. A demonstrated capability for fabrication of a high-speed frequency synthesizer on a single Integrated Circuit (IC) chip has opened new potentials for providing virtually all Army tactical voice communication radios with affordable Electronic Counter-Countermeasures (ECCM) capability. A new, efficient algorithm for applying the Fast Fourier Transform to intercepted enemy signals permits at least doubling the speed of Electronic Intelligence (ELINT) data processing for real-time acquisition and classification of enemy emitters.

b. (U) Microwave/Millimeter Wave Devices - A 70 GHz two-way line-of-sight secure voice binocular communications radio has been developed using low-cost electronic range guide integrated circuit technology to provide communications for a distance of 1 to 2 km under wide ambient temperature variations in dust, smoke, rain, and fog, and up to 8-10 km. A unique monolithic microwave amplifier has been designed and fabricated on a single chip of gallium arsenide and will provide significant advantages in size (reduction of 10 to 100X are projected), cost and performance, and opens up new capabilities in broadband receiver design for such applications as distributed jam-proof communications systems and Remotely Piloted Vehicles (RPV's) or space-borne radars. An improved electronic beam steerable silicon waveguide array antenna has been developed to satisfy the needs of high-resolution radars for terminal homing and for surveillance and target acquisition. A significantly improved higher efficiency IR source for the AN/ALQ-144 Countermeasures Set has been developed to protect rotary wing aircraft against heat seeking missiles in combat environments.

c. (U) Passive Devices - A low-cost, broadband ferrite phase shifter (35 GHz) has been designed and fabricated for use in electronic-scan phased array millimeter antenna systems proposed for use in helicopters, tanks, mini-Remotely Piloted Vehicles surveillance radars and Electronic Warfare (EW) receivers. A low- cost wideband surface acoustic wave (SAW) L-band oscillator (1680 MHz) has been developed for Army navigational and meteorological radiosonde applications. Extremely rugged high-stability, high-shock crystals, fabricated using special in-house developed designs and processes, have now successfully

Program Element: #6.27.05.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

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

passed the qualifying shock tests (12,000 to 23,000 gs) in field test firings from a 155 mm howitzer for Remotely Battlefield Sensor System (REMBASS) application. A thin film electroluminescent flat panel display has been developed which has potential (with improved resolution and contrast) for use in Army Communicative Technology Terminals and for a wide variety of intelligence, surveillance, and target acquisition (ISTA) and command, control and communications (C^3) systems.

d. (U) Power Sources - Significant progress was made in the development of high-performance lithium sulfur dioxide systems (double to quadruple the performance of existing systems) designed with an all-weather capability to operate forward area communications-electronics (C-E) equipment. A new 24-volt lithium-organic sulfur dioxide disposable primary battery, the BA-5557, has been developed for the Digital Message Device (DMD) of the TACFIRE system to replace the present limited capacity, rechargeable 28-volt Nickel-Cadmium Battery BB-557 for field operations. A high-energy, lightweight, fast-charge, all-weather, sealed nickel-cadmium battery, the BB-542( )/U, has been developed for the US Army Special Forces for use with a Burst Communications System. A compact power converter has been developed to provide a new approach to design of multikilowatt AC-to-DC converters supplying precision controlled 28V direct current (DC) power to fielded digital systems from standard 3-phase 120/208V alternating current (AC) sources. This new technology will be applied to next generation designs of precision power supplies for voltage-critical digital subsystems (computers, signal processors, etc.) installed in mobile Army systems such as the FIREFINDER, missile-minders, etc. A major system improvement has been made in-house with the development of a 500 watt Thermoelectric Power Source, resulting in a 25% reduction in fuel consumption. The system is now capable of gross power output of 820 watts, with a future effort aimed at 1,500 watts, to provide both DC and AC output for use with the Army's new developing surveillance and communications system.

2. (U) FY 1980 Program:

a. (U) Microelectronics Devices - Complete experimental development of binary-analog correlator for use in a microprocessor-controlled low probability of intercept modem for communications in Nap-of-the-Earth navigation for the BLACKHAWK helicopter. Initiate work on a modular analog-analog correlator to operate as a high-speed microprocessor for addressable memory, pattern recognition, and non-cooperative target identification. Complete development of high-speed short channel metal oxide silicon semiconductor arrays for high-speed signal processing applications. Define the system architecture and modular functions for a joint EW Laboratory program for a "Modular Adaptive Signal Sorter System". Initiate a symbolic computer-aided design capability for the rapid, cost-effective design of standard Large Scale Integrated (LSI) circuits and subchip designs to reduce overall cost of design and fabrication of ICs for a multitude of military applications.

b. (U) Microwave/Millimeter Wave Devices - Complete the development of radar receiver for operation at 94 GHz and initiate development of components for operation at 220 GHZ--required for Moving Target Indicator (MTI) radars for target

Program Element: #6.27.05.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)
Title: Electronics and Electron Devices
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acquisition, penetrating smoke, dust, fog, and adverse weather. Complete the development for first-generation (4 nanosecond) pulsers (modulator systems) for millimeter wave and carbon dioxide (CO_2) laser transmitters for antitank missile guidance and air defense systems. Complete the development of 3-5 micrometer (um) long-life high-efficiency Infrared (IR) source for use in the AN/ALQ-144 (Army, Navy, and Air Force Infrared Countermeasures (IRCM) for helicopters). Complete the development/evaluation of I/J band low-cost microwave jammer tube.

c. (U) Passive Devices - Complete development of low-loss, high-performance surface acoustic wave (SAW) bandpass filter at L-band for application to receiver front-ends, and SAW programmable matched filters for remotely piloted vehicles (RPV's) data links and Identification Friend or Foe (IFF) systems. Complete development of SAW oscillator for radiosonde and compact, low-power fast-frequency-hopping synthesizer for manpack application. Complete development of radiation hardened high-precision crystals required for the Single Channel Ground Airborne Radio Systems (SINCGARS) and Global Positioning System (GPS) navigation systems. Initiate the development of a tactical video sunlight-legible display for Project Manager, Tactical Fire Direction System (TACFIRE) Project Manager, Field Artillery Tactical Data Systems, Battlefield Surveillance Target Acquisition Radar (BSTAR), and Army Communicative Technology.

(d) (U) Power Sources - Complete development of first-generation high-rate lithium battery structures and continue development of second-generation lithium batteries having an expected 50% increase over present lithium batteries. Evaluate batteries for throwaway-type application such as portable forward area night vision observation devices which currently use rechargeable batteries not meeting performance requirements. Complete development of 2.5 kW AC-to-DC power processor using the new high-frequency active filtering technique which reduces the size and weight by 30-40%.

3. (U) FY 1981 Planned Program:

a. (U) Microelectronic Devices - Establish feasibility of high-speed GaAs large-scale integrated circuits for planned use in high-speed signal processing in fire and target missiles and Electronic Counter-Countermeasure (ECCM) applications. Establish architecture, device design, and complete fabrication of modular analog-analog programmable correlators to upgrade missile guidance/target acquisition systems. Design and fabricate an electrically alterable programmable logic array for high-speed signal processors. Initiate development of completely militarized 16 kilobit Reliability, Availability, and Maintainability (RAM) and high density military memory modules for insertion into the Joint Tactical Information Data System (JTIDS) and Army Distribution Data System (ADDS) packet radio system. Complete the Modular Adaptive Signal Sorter design and fabricate a brassboard illumination detector. Continue the development of high-level symbolic computer aided design capability with emphasis on automatic, cost-effective logical and electrical verification of large scale integrated circuits and subchips

Program Element: #6.27.05.A
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and demonstrate its capability in a high performance EW system. Continue the Department of Defense (DOD) Very High Speed Integrated Circuit (VHSIC) program to provide high throughput signal ard data processing subsystems in fire-and-forget missiles, wideband data communications, electronic warfare, and signal intelligence.

b. (U) Microwave/Millimeter Wave Designs - Initiate development of millimeter wave monolithic GaAs dielectric waveguide integrated circuit receivers at 94, 140, and 220 GHz for mini-RPV's, Helicopter All-Weather Target Acquisition Designation System (HAWTADS, BEAMRIDER, and Advanced Cannon Launched Guided Projectile (CLGP)) applications. Initiate development of Impact Avalanche Transit Time (IMPATT) diode sources and diode combiners to develop higher power levels (10-20 watts) to extend range of acquisition radars well beyond 3 kilometers. Integrate the solid state (4 ns) pulsers (developed in FY80) with MM Traveling Wave Tubes (TWTs)/magnetrons and evaluate/demonstrate its operation in acquisition and tracking radars. Continue development of 8-14 um IR source to optimize the suitability for countermeasures applications. Initiate development of low-cost ($5K) TWT for FIREFINDER and PATRIOT decoy--tubes presently costing $40K. Initiate a 3-year development of Continuous Wave (CW) electron beam semiconductor (EBS) communications jammer subsystem for Signal Warfare Laboratory.

c. (U) Passive Devices- Develop asynchronous, jam-resistant Surface Acoustic Wave (SAW) correlators for processing arbitrary waveforms at frequencies up to 600 MHz for use in next-generation Army tactical equipment--including jam-resistant tactical data links and C^3 systems. Develop compact, low power, fast frequency hopping SAW synthesizer operating at L-band for manpack applications. Initiate the development of low thermal hysteresis temperature compensated quartz resonators with low aging rates and vibration resistant for navigation systems. Complete development of 6-inch tactical video sunlight legible display for Program Manager (PM) TACFIRE/TACS, BSTAR and Army Communicative Technology.

d. (U) Power Sources- The Cathode discharge rate of second-generation lithium batteries will be improved and lithium cell designs will be established for moderate rate performance without the disadvantages of voltage delay--required for powering digital type equipments. Initiate studies on third-generation lithium cells to double the energy density over first-generation cells (200 watt hours per pound vs. 100). Develop resonant switching technique for DC to AC inversion to obtain high quality AC power from raw DC sources. Develop low-cost Thermo-Electric (TE) material elements for solar energy conversion.

e. (U) The total number of personnel supporting this project is 140 (professional 90, support 50).

4. (U) FY 1982 Planned Program:

Program Element: #6.27.05.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

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

a. (U) Microelectronic Devices - Develop integrated circuit technology which capitalizes on use of high-speed Galium Arsenide (GaAs) materials for use as charge coupled devices for achieving high-speed output circuitry. Complete fabrication and testing of prototype high-speed Silicon on Sapphire (SOS) frequency synthesizers for use in existing communications and data link equipment. Demonstrate the capability and feasibility of utilizing advanced LSI having improved performance capability in selected Army systems such as: synthesizers for SINCGARS, Position Location Reporting System (PLRS), Joint Tactical Information Distribution System (JTIDS); target acquisition processors for the Standoff Target Acquisition System (SOTAS); signal processors for a millimeter wave (MMW) intercept receiver; and a terrain map processor for Nap-of-the-Earth Navigation. Complete the development of a computer-aided layout design of hybrid microcircuits and distribute software to 48 defense contractors and Government agencies.

b. (U) Microwave/Millimeter Wave Devices - Continue development of monolithic GaAs Dielectric waveguide integrated circuit receivers at 94, 140, and 220 GHz with exploratory work at 340 GHz for use in mini-RPVs, Helicopter All Weather Target Acquisition Designation System (HAWTADS) and BEAMRIDER applications. Complete the development of plasma cathode thyratron switch for high repetition rate radars. Complete the development for prototype 8-14 um IR emitter source/modulator devices for use in countermeasures equipment against threats in this frequency range. Complete experimental work on Electron Beam Semiconductor Communications Jammer. Develop high current density (8-10 amp/cm ^{2}) cathode with improved life (5X improvement) for MMWave tubes planned for use in tank/fire control and airborne (RPV) radar transmitters.

c. (U) Passive Devices - Continue the application of double-rotated cuts of quartz to the development of oscillators with significantly improved frequency-temperature characteristics and much less sensitivity to acceleration, shock, and vibration. Optimize design of quartz high stability resonators (low aging, vibration resistant) to permit C^3, navigation and identification Friend or Foe (IFF) systems to operate in future battlefield environments. Initiate the development of a transparent flat panel display (5" x 7") with map overlay capability for automated systems requiring superposition of map and intelligence/radar data.

d. (U) Power Sources - High rate second-generation lithium cell development will demonstrate capability to meet high-power operational characteristics required for successful and effective operation of designator and night vision observation equipments. The capability of third-generation lithium thionyl chloride cells to meet high-power conditions normally addressed with rechargeable nickel cadmium batteries will be demonstrated at temperatures expected to be encountered in field operations. Design and evaluate breadboard DC to AC converter; transfer technology to 6.3. Design a thermoelectric generator/photovoltaic hybrid solar energy converter to achieve an improved efficiency of 25%.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.06.A Title: Chemical Biological Defense and General Investigation
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base
Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	12886	12431	12330	12687	Continuing	Not Applicable
A553	Chemical/Biological (CB) Defense and General Investigations	12886	12431	12330	12687	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army, as the Department of Defense (DOD) Executive Agent, has responsibility for conducting a coordinated inter-service Research, Development, Test and Evaluation (RDTE) program to provide the essential technology base upon which the Services can develop deterrent/retaliatory 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 agents/munition systems; to enhance all aspects of physical defense including warning, detection, identification, decontamination, individual and collective protection; to investigate chemical compounds of military interest; to evaluate protection countermeasures, avoid technological surprise, and uncover leads for new retaliatory 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 retaliatory chemical agents/munitions technology.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: The program will include the completion of the exploratory development (XD) of the Advanced Chemical Agent Alarm Detector (ACADA) which will detect lewisite and mustard agents, have increased sensitivity for nerve agent and include surface surveillance capability. Also: complete investigation of facemask filter plugging by battlefield particulates; complete investigation of the flow characterization and measurement of thickened liquids to describe their behavior in defensive and deterrent/retaliatory systems; continue investigation of innovative means of chemical, thermal, and radiative decontamination as well as the mechanical removal of contamination. Laser photolysis, microwave, and high

Program Element: #6.27.06.A Title: Chemical Biological Defense and General Investigation
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

intensity infrared are examples of innovative decontamination concepts. Continue identification and assessment of candidate persistent and nonpersistent training and trailing simulant agents. Initiate XD of an improved personal decontamination kit. Initiate studies on charcoal regeneration concepts to increase useful field life of filters, overgarments and other charcoal/-bearing chemical protection materials. Initiate XD on biological agent test kit. Continue search for new/improved protective mask materials that fully satisfy military requirements for operation at environmental extremes, resistance to field solvents, and durability.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	12886	12431	12330	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	12186	12543	12679	Continuing	Not Applicable

The increased FY 1979 funding provides the RDTE level of effort needed to support the joint-Service expanded chemical decontamination program. These requirements have been accelerated since submission of the FY 1979 Congressional budget requests. The FY 1981 decrease is due to the anticipated completion of exploratory development on selected innovative chemical decontamination concepts. The decrease in the FY80 funding estimate is the result of a general Congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.06.A Title: Chemical Biological Defense and General Investigation
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program 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 includes 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.

G. (U) 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 preclusion of duplicative efforts. Coordination and cooperation is maintained with allied countries via data exchange agreements, and with the North Atlantic Treaty Organization (NATO). Related technical investigations are conducted under PE 6.26.22, Chemical Munitions and Chemical Combat Support.

H. (U) WORK PERFORMED BY: In-house by United States (US) Army Chemical Systems Laboratory, Edgewood, MD. Contractors include Shock Hydronamics, Sherman Oaks, CA; Honeywell Incorporation, St. Petersburg, FL; Ash Stevens Incorporated, Detroit, MI; Batelle, Columbus, OH; Brunswick, Marion, VA; Southern Research, Birmingham, AL; Mine Safety Applicance, Pittsburgh, PA; Midwest Research Institute, Kansas City, MO; and Bendix, Towson, MD.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishment: During 1978, the following were accomplished: completed exploratory development (XD) on the detector kit for chemical agents in water, and the ionization detector which enhances the sensing capability of the M8 Chemical Alarm System. Additionally, the feasibility of laser remote sensing techniques was completed; and conceptual studies for simplified collective protection for field shelters and residual gas-life indicator for large area filters were completed. In FY 1979, the following were accomplished: completed XD on the decontamination apparatus for vehicles (DAV), and the Automatic Liquid Agent Detector (ALAD); completed evaluation of the German 7-ton decontamination unit; and completed construction of prototype for rapid decontamination system (jet exhaust decontamination system). It was confirmed that the protective overgarment can be worn for 28 days in a nontoxic environment and continue to meet protection criteria when exposed to toxic chemicals. XD on the simplified collective protection equipment was initiated.

Program Element: #6.27.06.A Title: Chemical Biological Defense and General Investigation
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

2. (U) FY 1980 Program: Complete investigation of facemask filter plugging by battlefield particulates and draft report. Complete exploratory development of ultra sensitive cell enzyme for chemical vapor detection in the M256 detector kit. Complete the evaluation of prototype simplified collective protection equipment. Complete concept studies on "probe in bed" technique for residual gas life indicator for individual and collective protection filters. Also: Continue assessment of the vulnerability of US forces to potential chemical and biological threat agents; continue fabrication and comparative evaluation of jet exhaust and steam/hot water decontamination systems against chemical, biological and radiological contamination; continue exploratory efforts on second generation remote chemical sensor for detecting a broad spectrum of chemical agents in all physical states; continue exploratory development of the Advanced Chemical Agent Detector Alarm (ACADA); emphasis will be on blister and nerve agent detection as well as surface surveillance to determine the presence of contamination and/or completeness of decontamination. Initiate search for new/improved protective mask materials that fully satisfy military requirements for operation at environmental extremes, resistance to field solvents, and durability.

3. (U) FY 1981 Planned Program: Complete exploratory development (XD) of the Advanced Chemical Agent Detector Alarm (ACADA). Also: complete report of facemask filter plugging by battlefield particulates; complete investigation of the flow characterization and measurement of thickened liquids to describe their behavior in defensive and deterrent/retaliatory systems; continue investigation of innovative means of chemical, thermal and radiative decontamination, as well as, mechanical removal of contamination. Laser photolysis, microwave, and high intensity infrared are examples of innovative decontamination concepts. Continue identification and assessment of candidate persistent and nonpersistent training and trailing simulant agents. Initiate XD on an improved personal decontamination kit. Initiate studies on charcoal regeneration concepts to increase useful field life of filters, overgarments, and other charcoal bearing chemical protection materials. Initiate XD on biological agent test kit. Initiate studies to evaluate potential threat of collective protection filter plugging by battlefield particulates. Number of personnel supported: professional 133; support 45.

4. (U) FY 1982 Planned Program: Continue to assess effectiveness of protective and detection systems against all potential threat agents in tri-Service environments. Continue identification and assessment of candidate persistent and nonpersistent training and trailing simulant agents. Continue studies on charcoal regeneration concepts to increase useful field life of filters, overgarments, and other charcoal/bearing chemical protection materials. Also continue the investigation of collective protection filter plugging by battlefield particulates. Continue XD on: (1) an improved personal decontamination kit, (2) biological agent test kit, and (3) innovative means of chemical, thermal, and radiative decontamination as well as mechanical removal of contamination.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.07.A
DOD Mission Area: #522 - Evironmental and Life Sciences

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

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4200	4466	5652	5702	Continuing	Not Applicable
A855-A	Geodetic & Positioning Technology	912	558.0	1261	1483.9	Continuing	Not Applicable
A855-B	Topographic Mapping Technology	1590	1731.6	2388.2	2129.9	Continuing	Not Applicable
A855-C	Military Geographical Analysis Technology	1698	2176.4	2002.8	2088.2	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program investigates and develops methods and equipment to provide the Field Army and Department of Defense a more responsive and cost effective capability for collecting, processing, displaying and disseminating geodetic, topographic and military data and products to satisfy tactical and strategic needs of the Army & DOD for accurate and near real-time position, azimuth and evaluation data and terrain information in support of military operations.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: FY 1981 support to Defense Mapping Agency includes the development of digital techniques for imagery data extraction and elevation determination and the use of holographic and other coherent optical techniques for image data extraction. FY 1981 program support to Field Army includes: gyroscopic azimuth devices for artillery survey application; low-cost optical/inertial techniques for rapid determination of accurate positional data; improved map designs and production procedures for tactical operations and planning; imagery correlation facilities for near-real-time targeting and positioning; advanced methods and materials in support of baseplant and field map reproduction.

Program Element: #6.27.07.A Title: Mapping and Geodesy
DOD Mission Area: #522 - Evironmental and Life Sciences Budget Activity: #1 - Techonolgy Base

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES; ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Costs
RDTE					
Funds (current requirements)	4200	4466	5652	Continuing	Not Applicable
Funds (as shown in FY 1979 submission)	4200	4524	4400	Continuing	Not Applicable

The increases shown in the FY 1981 submission for fiscal year 1981 over the FY 1980 submission result from increased technology base support to the Defense Mapping Agency (DMA) to meet gravity and positioning requirements of advanced strategic weapons and for image data extraction technology for map production. The increase also supports initiation of efforts to integrate terrain data with meteorology and intelligence information to provide Army field commanders more timely and coordinated tactical information. The decrease in FY 80 is the result of a general congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.07.A Title: Mapping and Geodesy
DOD Mission Area: #522 - Evironmental and Life Sciences Budget Activity: #1 - Techonolgy Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The Mapping & Geodesy Technology Base Program develops new or improved means for rapid acquisiton, processing, and dissemination of positional information, mapping data and military geographic information. End items directly support future map production and topographic support activities affecting strategic and tactical deployment of forces and weapons systems. Program covers areas of Geodesy and Point Positioning, Mapping and Geographic Analysis, and provides the 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. The program addresses science & technology objectives for Command Systems, Intelligence/Surveillance/Target Acquisition and Fire Support capability categories in the Army Science & Technology Objectives Guide (STOG).

G. (U) RELATED ACTIVITIES: This Program Element applies results of basic research performed under Program Element 6.11.02, Defense Research Sciences, Project B52C, Mapping and Geodetic Research. Both Air Force and Navy have related mission-oriented research, which is coordinated with the Army's program by the Defense Mapping Agency (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 Program 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 Test; Army Program Element 6.37.12.A, Mapping and Geodesy; and Army Program Element 6.47.16.A, Mapping Geodesy. Duplication of research is avoided by annual DOD Apportionment and Budget Reviews, DMA Technology Base Reviews, periodic DOD Topical Reviews and technical coordination among the service research laboratories.

H. (U) WORK PERFORMED BY: Approximately 70% 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 for FY 81 will be $1,361M. The five major contractors are: Xerox Electro-Optical Systems, Pasadena, CA; Litton Industries, Woodland Hills, CA; DBA Systems Inc., Melbourne, FL; University of Kansas, Lawrence, KA; Perkins-Elmer, Danbury, CT. There are 9 additional contracts totaling $272K. Other government agencies funded by this project include: Rome Air Development Command, Rome, NY; and the Electromagnetic Compatibility Analysis Center, Annapolis, MD.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: A rapid gravity survey system was developed to provide a capability for the Defense Mapping Agency (DMA) to support the geodetic requirements of strategic missiles. A prototype design was developed for a quick-response multi-color printer to enable field Army rapid reproduction of special map products and terrain information. A digital image analysis facility was developed to provide a comprehensive in-house capability for research to develop rapid methods

Program Element: #6.27.07.A Title: Mapping and Geodesy
DOD Mission Area: #522 - Evironmental and Life Sciences Budget Activity: #1 - Techonolgy Base

for image data extraction to meet DMA map production and field Army needs. Techniques were developed for analog/digital processing of terrain data for preparation of factor map overlays to support Army requirements for special map products and terrain analysis.

2. (U) FY 1980 Program: Exploratory development efforts on the miniature gyrocompass and the low cost heading reference system will be completed. Both systems are aimed at providing the artillery with better weapon positioning and target location capabilities. A test program to determine target location in near-real-time using TV or other imagery will be completed. A hybrid optical/digital interactive feature extraction system will be developed for experimentation and test. This system is aimed at providing the Defense Mapping Agency (DMA) with improved photo interpretation equipment to expedite the production of digital terrain information for weapon system support. A field version of the system will be tested to demonstrate in a tactical environment, use of digital elevation data for command and control. Investigation of electronic or other techniques to provide, external reference for self-contained vehicle positioning systems to support Field Artilley positioning needs are being initiated.

3. (U) FY 1981 Planned Program: Priority emphasis and expanded efforts will be placed upon development of practical, short-range approaches toward satisfying the DMA need for rapid image feature extraction to support increased map production/revision; hybrid digital/optical/electronic techniques will be investigated. Research will be continued to develop digital methods for automated f ature extraction to meet long-range DMA production needs. Investigations will be initated to provide the technology base for the precise geodetic/gravity data needs of advanced strategic weapons. Exploratory development of an all-weather, automated distance and azimuth measuring instrument will be completed for artillery and engineer use. Investigations of externally referenced self-contained vehicle positioning systems will be completed. Feasibility demonstration of a variable geometry laser printer will be continued. Prototype development will be initiated on a mass graphic storage system for field Army use. Studies will be initiated to develop procedures and systems for processing and integrating terrain data, meteorology and intelligence information to provide Army Commanders an improved, timely base for tactical planning and operations. Studies will be undertaken to determine the feasibility of using advance gyroscopic technology for precise azimuth determination for missile support and as vehicle heading references. Personnel supported by this program include 63 professional and 6 support.

4. (U) FY 1982 Planned Program: In-house and contractual efforts will continue in the development and testing of advanced digital data extraction techniques. New investigations into automated cartographic techniques will be initiated. A state-of-the-art assessment of advanced field survey techniques will be conducted to identify new approaches applicable to field Army positioning. Development and testing will continue on feature extraction devices, multi-image automated interpretation techniques, and experimental software for terrain intelligence models.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.09.A Title: Night Vision Investigations
DOD Mission Area: #521 - Electronics & Physical Science (ED) Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7799	9183	11402	14529	Continuing	Not Applicable
DH95	Night Vision Investigations	7799	9183	11402	14529	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army has a need for a cost-effective means to fight during periods of darkness and limited visibility with a relative combat capability that is equal to that of day. This program element supports the development of technology to ensure the United States (US) maintains its lead in the ability to acquire and engage targets under all battlefield conditions. This combat capability is required to counter the threat of a foe who plans and trains to continue combat operations 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 performance improvements for night vision devices.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Funds requested provide for research and exploratory development to improve performance effectiveness, simplify, and reduce life cycle costs of future night vision systems. Major efforts will be in the areas of Visionics, Thermal Imaging, and Lasers. Visionics - Continue development of tactical search and target acquisition models to determine least costly techniques for satisfying requirements. Models will be upgraded to incorporate the adverse effects of camouflage, atmospheric conditions, and countermeasures based on data collected during field experiments. Thermal Imaging - Continue development of forward looking infrared (FLIR) devices with a tenfold increase in sensitivity for penetration of obscurants, e.g., fog, smoke, dust. Develop technology base for third generation infrared systems and multispectral imagers which will have greatly improved performance over present systems. Continue development of uncooled thermal detectors to eliminate the need for cryogenic or thermoelectric coolers. Conduct further research into lightweight electro-optical sensor and target seekers for use in terminal homing of smart munitions. Laser - Develop Carbon Dioxide (CO_2) lasers to provide for penetration of obscurants equal to that of infrared systems. Integrate these lasers with hetrodyned forward looking infrared to form an all weather target sensing system, as well as new precision laser designators. All of these efforts are pointed toward improving the Army's ability to acquire and engage targets under all weather conditions.

Program Element: #6.27.09.A Title: Night Vision Investigations
DOD Mission Area: #521 - Electronics & Physical Science (ED) Budget Activity: #1 - Technology Base

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	7799	9183	11402	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	6063	9183	11940	Continuing	Not Applicable

Increase in FY 1979 ($1936) was for transfer of laser technology from Program Element 6.27.03.A, Combat Surveillance Target Acquisition and Identification, to this program. Decrease in FY 1981 ($538) is due to program realignment and higher priority projects.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.09.A Title: Night Vision Investigations
DOD Mission Area: #521 - Electronics & Physical Science (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This effort covers exploratory research and development of components, techniques, man/machine models, and environmental data bases essential for both significant cost reductions and performance improvements in night vision electro-optical devices. The Visionics program is primarily concerned with the development of tactical effectiveness models, the refinement of a target signature data base, and the exploitation in technology demonstrator configuration of new sensor ideas and concepts. The performance and field utility of sensors for both direct acquisition and weapons system applications are studied using analytical models. Results from these models are the basis for engineering judgments of technological concepts prior to hardware development. Models are used to portray realistically the performance of the various sensors on the active battlefield against various threat weapon systems. These simulation models include both the "man in the loop" and automatic features for unmanned applications. Far Infrared thermal imaging technology is directed toward fabrication and initial testing of second generation Forward Looking Infrared (FLIR) and the Surveillance Target Acquisition Radar for Tank Location and Engagement (STARTLE). A new generation of high-performance FLIR systems is being developed which uses high-density, Charge Coupled Device (CCD) focal plane arrays. The CCD effort seeks to double the standoff range of present FLIR in airborne applications and greatly enhance the performance of combat vehicle FLIR under conditions of poor visibility. Increased search effectiveness is provided by automatic target cueing and image enhancement techniques. Large two-dimensional staring focal plane arrays which integrate the CCD signal processing with 8-12 micron detectors offer significantly improved system sensitivity while reducing mechanical and optical complexity. Prototype demonstrator systems are the Advanced Tactical (ATAC) FLIR for the Advanced Attack Helicopter and the High Sensitivity Tank FLIR (HISTAF). The concept of a common module carbon dioxide laser and definition of a family of compact modular elements compatible with FLIR is being developed. Applications of this laser family include range finders, battlefield Identification Friend or Foe, beamrider missile guidance, target designators, and wind sensors. Common modules and interface elements for integration with FLIR are constructed and tested. Because of the noncommercial aspects of night vision and electro-optical technologies, it is essential to maintain internal research and development activity.

G. (U) RELATED ACTIVITIES: Close coordination is maintained with the Navy, Air Force, and Marine Corps to avoid duplication. Through the Joint Logistics Commanders (Army, Navy, and Air Force) coordinating groups have been established to ensure that maximum use is made of limited assets, e.g., the 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 the National Atlantic Treaty Organization (NATO) and the Quadripartite countries (America, Britain, Canada, and Australia).

Program Element: #6.27.09.A Title: Night Vision Investigations
DOD Mission Area: #521 - Electronics & Physical Science (ED) Budget Activity: #1 - Technology Base

H. (U) WORK PERFORMED BY: Night Vision Laboratory, Fort Belvoir, VA. Representative contractors are: Philco Ford Corporation, Aeronutronics Division, Newport Beach, CA; Martin-Marietta, Orlando, FL; Hughes Aircraft, Culver City, CA; and Texas Instruments, Dallas, TX.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Second-generation image intensifier tubes have been developed and are now in production. Gallium arsenide photo cathode technology for third-generation intensifiers with greatly increased sensitivity and reliability has been developed and is now in night vision goggles in Engineering Development. In the Visionics area, models to predict range of intensifier and visual search performance completed, and techniques established to include the effects of smoke and target signature variation on the evaluation of electro-optical viewing systems. Programs were initiated to develop a flat panel helmet-mounted display for use by helicopter pilots, and a miniature camera tube for possible use in Remotely Piloted Vehicles (RPV's). A second-generation Thermal Imaging program to demonstrate high-density detector focal planes, up to 2000 detectors, was initiated. Uncooled, high-performance infrared (IR) imagers were evaluated for applications such as driving through smoke and fog. Fabricate nonscanning, thermoelectrically (TE) cooled, staring focal plane (third-generation thermal) sensor, for possible application in automatic tracking imaging for smart munitions in the mid-1980's.

2. (U) FY 1980 Program: Continue development of second-generation Forward Looking Infrared (FLIR) and advanced concepts to penetrate smoke and foul weather to acquire targets. Development will be continued on concepts for smart sensor-seekers for terminal homing of munitions. Continue development of third-generation thermal imagers. Initiate development of 10.6 micron laser and hetrodyned forward looking infrared systems (FLIR's) which will be integrated into an all-weather target sensing system.

3. (U) FY 1981 Planned Program: Continue development of second-generation FLIR's for heliborne and armor/antiarmor applications with ranges compatible with increased missile ranges, 10.6 micron lasers, hetrodyned FLIR for foul weather penetration, and third-generation thermal imagers. Begin development of a high-reliability, low-cost, lightweight, nonscanning thermal system for use with self-guided munitions. This program element supports the work of 89 civilian professional and support personnel.

4. (U) FY 1982 Planned Program: Continue development of second-generation FLIR with improved performance for aircraft and combat vehicle application. Continue work on third-generation thermal imagers for low-cost, lightweight system

requirements. Continue development of laser sources in the .5-3 and 3-20 micron bands for target acquisition and integrated engagement systems.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.15.A
Title: Tactical Electronic Warfare Technology
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT					Continuing	Not Applicable
A042	Tactical Electronic Warfare Technology					Continuing	Not Applicable
A904	Tactical Electronic Warfare Techniques					Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program 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 CM environment.

C. BASIS FOR FY 1981 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, and Navy develop jamming mission system techniques. These goals will be pursued primarily through a continuation of work initiated in prior years. Waveforms for defeating radars will be optimized and the development of jamming sources

will continue. The effectiveness of various jamming techniques against missiles will be evaluated, improved jamming sources designed, and threat warning techniques investigated. The feasibility of fully automatic electronic countermeasures (CM) for protection from laser guided weapons will be established and efficient laser jamming sources developed. An effort to improve jamming antennas with a new matching unit will be undertaken. Techniques to increase resistance to jamming of communications systems will concentrate on the to microwave data links. Various modulation effectiveness measurements will be will be taken against in an effort to optimize jamming modulations so as to define define a minimum jamming to signal ratio and effectively utilize the effective radiating power (ERP) of existing and future radar jammers. A High power communications jamming amplifier will be evaluated to demonstrate its potential for future jammer applications. A prototype very high frequency communications jamming system will be developed for Remotely Piloted Vehicles.

D. BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	4250	7151		Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	4339	7151		Continuing	Not Applicable

FY 1979 decrease of $89 in Project A042 was due to reprogramming to meet higher priority requirements. Decrease in FY81 of $113 in Project A042 is due to budgetary constraints which preclude funding at desired level.

E. (U) OTHER APPROPRIATION FUND: Not Applicable

Program Element: #6.27.15.A Title: Tactical Electronic Warfare Technology

DOD Mission Area: #521 - Electronic and Physical Sciences (ED) Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is the exploratory development of tactical electronic warfare (EW), 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 hostile weapon systems and units. New and improved methods and techniques will be developed to provide for improvement of jamming and ECM/ECCM control by increasing operational effectiveness while reducing size and weight and increasing reliability. This program is also based on the need for continuous improvement of existing techniques and the development of new techniques for dealing with advances in 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.

G. (U) RELATED ACTIVITIES: This work is in direct support of the Program Manager for Aircraft Survivability Equipment and program elements: 6.37.45.A/D905 (Tactical Electronic Support Measures (ESM) Systems), 6.37.45.A/D925 (Tactical EW and Intelligence Command and Control Systems), 6.37.55.A/D251 (Protective EW Equipments), 6.37.55.A/DK12 (Division 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 EW 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). Tri-Service technical efforts in EW receive extensive review as a result of participating in Joint-Service Technical Programs ECCM Workshops and Joint Technical Coordinating Groups which reduce duplication among the Services. Coordination is also furthered through tri-Service preparation of a Technology Coordinating Paper on electronics and the annual 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.

H. (U) 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), Warrenton, VA; and White Sands Missile Range (WSMR), NM. Supporting efforts are provided by the US 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; Bunker Ramo Corporation, West Lake Village, CA, Sanders Assoc, Nasha, NH and Hazeltine Corp. Greenlawn, NY.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Special chaff was fabricated and tested and environmentally degradable chaff was demonstrated in the laboratory. Using special dissemination techniques, a chaff dispersion was obtained. Software for data acquisition and reduction on the has been initiated. Breadboard design has been started on the Countermeasure Program. In the Protection Technology program, the Smith Modulator and other potential have been tested and the threat analysis completed. Laser Warning Receiver (LWR) requirements have been established and a programmable Radar Warning Receiver (RWR) capable of has been developed. Wide Band preamplifiers for RWRs have been fabricated and the Laser Beamrider Analysis has been completed. The Air Defense Electronic Warfare System (ADEWS) prototype has had successful limited testing against and a Letter of Agreement (LOA) has been coordinated with approval anticipated in mid FY 1980. The modular adaptive signal sorter (MASS), being developed to provide flexibility against has demonstrated the Processor Breadboard model successfully. Successful field testing has proved the validity of using A technical breakthrough permitted the achievement of feasibility has been demonstrated in both the laboratory and the field. In a joint program with Naval Weapons Systems Lab, a jammer amplifier has been designed utilizing Electron Bombarded Semiconductor (EBS), active devices rather than conventional tubes or transistors. A computer analysis of the EBS device resulted in several design changes to improve its linearity and a new output circuit was design for greater power efficiency. Reliability problems have been solved and specifications written for a complete communications EBS Amplifier/Transmitter unit. Initial investigations in the electro-optics (EO) area demonstrated the feasibility

A continuous wave (CW) Heterodyne Receiver/Transmitter has been developed and tested to define limitations of Remotely-Piloted Vehicle (RPV) Electronic Warfare (EW) Mission System Techniques efforts centered on feasibility demonstration Preliminary antenna design concepts were investigated for both

broadband transmit and homing antennas and, through the Arms Research and Technology Lab at Ft. Eustis a contractual effort to fabricate a for use with a drone platform was started. In the antenna techniques area the Electronic Counter-Measures (ECM) computer analysis was completed and, due to the change of the AN/ALQ-151 (QUICK FIX) system from the UH-1H to the BLACKHAWK helicopter the effort was redirected and Very-High Frequency (VHF) ECM antenna investigations for the BLACKHAWK initiated.

2. FY 1980 Program: Complete core database for generic chaff will be compiled and a first-cut math model will be developed as well as measurement of the aerodynamic properties. Collection and storage techniques will be examined with an eye to reducing breakage. The development hardware will be fabricated and field evaluated and the effort will be transitioned to Advanced Development. investigations will continue with initiation of breadboard fabrication. The protection effort will include: Modifying the AN/ALQ-136 for flight test; A Lawer Warning Receiver (LWR) will be breadboarded; continuation of threat analysis; investigation of Stinger/Post vulnerability; evaluate ultraviolet (UV) detector; investigate techniques for testing of Radar Warning Receiver (RWR); gathering polarization and multispectral signature data; and developing a jammer brassboard. A Letter of Agreement (LOA) will be approved for the Air Defense Electronic Warfare System (ADEWS) and field verification testing will be done. The Modular Adaptive Signal Sorter (MASS) modules will be integrated into a brassboard and its LOA coordinated. analysis will be conducted and airborne field tests of the expendable radar targetting repeater will be held. Determination of the feasibility of approach will be made through simulation and analysis and the radio location targeting data base will be extended by using more difficult terrain. Determination of the baseline approach of to digital signals will be made and baseline equipment contract will be awarded. A contract will be awarded for a microwave receive/transmit module with emphasis on development of system sensitivity and antenna gain requirements. This module will be used in further radar jamming modulation investigations. A program to improve current DF antenna sensitivity will start with award of a contract to investigate various antenna designs, particularly in the Range, where conventional cavity-backed antennas provide inadequate gain. The Drone EW mission system effort will continue with tests of the system at Nellis Air Force Base and investigations of antenna and sorting parameters for the purpose of extending the lower frequency limit. The goal of this work is to determine whether the system has the potential to meet requirements and enter Advanced Developmgnt. collection techniques improvement will continue with design and procurement of an advanced recording system to collect signals for analysis. The Electron Bombarded Semiconductor (EBS) amplifier will be tested and evaluated prior to further transmitter

development using EBS technology. Heliborne and Drone mounted ECM antenna investigations will continue. The objectives of these efforts are a directional antenna for a System. Development of a modularly structured electro-optical (EO) computer model will continue. The EO search model and module will be developed and integrated into the E/O model.

3. FY 1981 Planned Program: Generic chaff investigations will continue database measurements and the initiation of techniques. laboratory and field tests will be completed and spectrum susceptibility studies of the effects will be conducted. The breadboard will be completed and laboratory and field tests conducted. Protection effort will consist of: Flight test of the AN/ALQ-136 modification; evaluation of Laser Warning Receiver (LWR) Brassboard; measurement of jamming effectiveness against a initiation of dynamic threat model; Brassboarding of Area Counter-Measures (CM); testing of Radar Warning Receiver (RWR); and field testing of a Brassboard Jammer. The Air Defense Electronic Warfare System (ADEWS) will transition to Advanced Development (AD). Large-Scale Integration (LSI) modules of the Modular Adaptive Signal Sorter (MASS) will be tested and evaluated, and the basic processor will be transitioned to AD. System components of system will be designed and Radar Targetting trade-off analysis will be conducted. The repeater brassboard will be fabricated and the Letter of Agreement (LOA) is expected to be approved. Breadboarding of a system will be done. Tactically acceptable configurations of Radiolocation Targetting components will be determined and a plan for a field demonstration will be developed. techniques investigation will continue. Non-Communications Jamming Modulation Analysis efforts will continue with measurement of modulation effectiveness against a typical radar and evaluation of jamming vice spot vice other methods. A program to develop a jamming antenna system for ground or airborne systems with measurements of antenna gain, beam patterns, power handling capability and efficiency will begin. A model of the selected non-communications conformal antenna and start testing to verify performance estimates and predictions will be constructed. Frequency extension efforts for Drone Electronic Warfare (EW) mission system techniques with optimization of sorting and identification to provide a capability will continue. Investigation of potential vulnerability of emerging communications to Electronic Counter-measures (ECM) will continue. Techniques to detect, collect and process emissions and complete configuration of the in-house system will be investigated. Vertical Metal Oxide Semiconductor Field Effort Transistors (VMOS FET) will be used as the foundation for new high power module (BPM) development. The BPM should lead to more effective and efficient high output power. Breadboard models of the best antenna and matching units for jamming antennas will be developed and feasibility testing with emphasis on drone applications will be conducted.

Program Element: #6.27.15.A Title: Tactical Electronic Warfare Technology
DOD Mission Area: #521 - Electronic and Physical Sciences (ED) Budget Activity: #1 - Technology Base

4. FY 1982 Planned Program: Initiation of techniques and fabrication of environmentally degradable chaff will be done under the generic chaff Program. will be transitioned to AD and the Brassboard will be completed and subjected to field demonstration/testing. The Protection Program will continue with evaluation of the AN/ALQ-136 flight tests, completion of model, and atmospheric measurements, testing of Area CM brassboard, study of and transition of jammers to AD. A broadband for front end preprocessing will be developed to interface with MASS. The design of an advanced system will be completed and model fabrication will begin. Radar targetting brassboard will be completed and tested and a feasibility study for a Product Improvement Program will be conducted. The system breadboard will be completed and subjected to field evaluation. A radiolocation targetting test bed will be built and field demonstrations completed and techniques refined. investigations will begin. Software for signal will be initiated. High power jammer modulations will be tested, A high power amplifier complete conformal antenna project will be designed. JAM/SEEK work, vulnerability study, and electro/optics intelligence and Electronic Warfare data base will be continued. receiver system will be tested overseas, and Jammer concepts will be studied. Vertical Metal Oxide Semiconductor Field Effect Transistors Amplifier will be developed and built.

5. (U) Program to Completion: This a continuing program as methods of communications/electronics, IR and electro-optics become more sophisticated, the Army's electronic warfare equipments/systems must also advance/improve in order to effectively counter new threats. Conversely as new and advanced EW techniques and systems evolve, better electronic counter-countermeasures techniques must be developed if the Army's electronic and weapons systems are to maintain their operational effectiveness in an electronic warfare environment.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A042 Title: Tactical Electronic Warfare Techniques
Program Element: #6.27.15.A Title: Tactical Electronic Warfare Technology
DOD Mission Area: #521 - Electronics and Physical Science (ED) Budget Activity: #1 - Technology Base

A. DETAILED BACKGROUND AND DESCRIPTION: Improve Army tactical electronic warfare (EW) capability to: (1) Protect both air and ground forces against radar, electro-optical (EO) and infrared (IR) homing missile threats and radar and optically guided weapons; (2) intercept, identify, locate, target, and counternand command, control, and communications (C^3), Data Links, Intelligence Surveillance and Target Acquisition (ISTA) Systems, Radar, EO and IR, as well as missiles and other weapons by means of new, adaptive and expendable EW techniques; (3) Reduce vulnerability of friendly communications electronic (CE) and missile systems to hostile EW actions by electronic counter-countermeasures (ECCM) hardening. The primary payoff of increased combat effectiveness, resulting from an enhanced Army Tactical EW Capability will be manifested in improved real time assessment of the hostile battlefield environment, quicker and more accurate counterfire, increased survivability of personnel and equipment. and sustained C^3 despite hostile EW actions. For noncommunications EW the approach is to develop a new generation of compatible equipment, both modular and expendable. This equipment will permit deployment in high-risk areas and provide realtime mission capabilities while circumventing some of the inherent constraints of ground operation and low performance, constrained airborne platforms. For communications targeting, methods to accomplish multipath compensation will be pursued. For the protection of combat systems the general approach is to provide warning, jamming, or decoying of the weapon and/or weapon operator. A family of warning receivers will be developed which are capable of,
To accomplish effective jamming against the new radars and missiles which contain numerous ECCM features, will be developed. will be developed which will deploy rapidly and much better match the characteristics of the protected target to defeat cancellation schemes. For the vulnerability/ECCM area the approach includes development of ECCM technology for communications, development of ECCM technologies for combat surveillance systems and development of EW threat technologies for use in EW missile vulnerability programs.

B. (U) 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), 6.37.45.A/D925 (Tactical Electronic Warfare and Intelligence Command and Control Systems), 6.37.55.A/D251 (Protective Electronic Warfare (ED) Equipment) 6.37.55.A/DX61 (Expendable Jammers), 6.37.18.A/D626 (Non-Missile Vulnerability/Susceptibility), 6.37.18.A/D267 (Missile Vulnerability/Susceptibility), 6.37.55.A/DX12 (Division Tactical Electronic Countermeasures (ECM) Systems), 6.37.55.A/DX13 (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), 6.47.50.A/DX62 (Expendable Jammers),

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 noncommunications. Tri-Service technical efforts in electronic warfare receive extensive review as a result of participating in Joint Service Technical Programs (JSTP), Electronic Counter-Countermeasures 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). Numerous specific subtasks are conducted on an interservice 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.

C. (U) WORK PERFORMED BY: The Electronic Warfare Laboratory, US Army Electronics Research and Development Command, Fort Monmouth, NJ, is the in-house developing organization responsible for this project. Contractors providing support to this program during FY79 include: Signatron, Lexington, MA, SRI, Arlington, VA, Calspan, Buffalo NY, RCA Corp, Burlington, MA, Sanders, Nashua, NH, Varo, Garland, TX, Tasker, Chatsworth, CA, Hughes, Culver City, CA, ITT Avionics, Nutley, NJ, Perkin-Elmer, Wilton CN, Martin Marietta, Orlando, FL, AEL, Landsdale, PA, Haseltine, Greenlawn, NY, with contracts totaling over $1.25 million.

D. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: has been fabricated and tested and environmentally degradable chaff has been demonstrated in the laboratory. Using Office of Missile Electronic Warfare (OMEW) dissemination techniques, a chaff dispersion efficiency of approximately, has been obtained in the Software for data acquisition and reduction on the has been initiated. Breadboard design has been started on the Countermeasure Program (formerly called In the Protection Technology program, the Smith Modulator and other potential, have been tested and the Threat Analysis completed. Laser Warning Receiver (LWR) requirements have been established, and a programmable Radar Warning Receiver (RWR) capable of has been developed. Wide Band preamps for RWR's have been fabricated, and the Laser Beamrider Analysis has been completed. Air Defense Electronic Warfare System (ADEWS) prototype has had successful limited testing against and the Letter of Agreement (LOA) has been

coordinated with approval anticipated in mid-FY80. The modular adaptive signal sorter (MASS), being developed to provide flexibility against has demonstrated the Processor Breadboard model successfully. Successful field testing has proved the validity of using A technical breakthrough permitted the achievement of feasibility has been demonstrated in both the laboratory and the field.

2. FY 1980 Program: Complete core data base for generic chaff will be compiled and a first-cut math model will be developed as well as measurement of the special Collection and storage techniques of will be examined with an eye to The devel pment hardware will be fabricated and field evaluated, and the effort will be transitioned to advanced development (AD). investigations will continue with initiation of breadboard fabrication. The protection effort will include: Modifying the for *flight test; Laser Warning Receiver* (LWR) will be breadboarded; continuation of threat analysis; investigation of Stinger/Post vulnerability; investigate techniques for testing of RWR; gathering polarization and multispectral signature data; and developing jammer brassboard. Letter of Agreement (LOA) will be approved for ADEWS, and field verification testing will be done. The MASS modules will be integrated into Brassboard and its LOA coordinated. analysis will be conducted, and Airborne field tests of the repeater will be held. Determination of the feasibility of approach will be made through simulation and analysis and the radio location targeting data base will be extended by using more difficult terrain. Determination of the baseline approach of to digital signals will be made, and baseline equipment contract will be awarded.

3. FY 1981 Planned Program: Generic chaff investigations will continue data base measurements, and the initiation of techniques. laboratory and field tests will be completed, and spectrum susceptibility studies of the effects will be conducted. The breadboard will be completed and laboratory and field tests conducted. Protection effort will consist of: Flight test of the AN/ALQ-136 mod; evaluation of LWR Brassboard; measurement of jamming effectiveness against a missile; initiation of model; Brassboarding of Area CM; testing of RWR; and field testing of Brassboard Jammer. ADEWS will be transitioned to AD. Large-scale integrated (LSI) modules of MASS will be tested and evaluated, and the basic processor will be transitioned to AD. System components of Advanced system will be designed and Radar Targeting trade-off analysis will be conducted. The repeater brassboard will be fabricated and the LOA is expected to be approved. Breadboarding of a

system will be done. Tactically acceptable configurations of Radio Location Targeting components will be determined, and a plan for a field demonstration will be developed. techniques investigation will continue. Approximately eighteen professional and two support personnel at the Electronics Warfare Laboratory are involved with program management, contract monitoring and a limited amount of in-house laboratory experimentation and modeling.

4. FY 1982 Planned Program: Initiation of techniques and fabrication of environmentally degradable chaff will be done under the generic chaff Program. will be transitioned to AD, and the Brassboard will be completed and subjected to field demonstration/testing. The Protection Program will continue with evaluation of the ALQ-136 flight tests, completion of model, and atmospheric measurements, testing of Area CM brassboard, study of and transition of Beamrider Jammers to AD. A broadband for front-end preprocessing will be developed to interface with MASS. The design will be completed of an advanced jamming system, and model fabrication will begin. Radar targeting brassboard will be completed and tested and a feasibility study for a PIP will be conducted. The system breadboard will be completed and subjected to field evaluation. A Radiolocation targeting testbed will be built, and field demopstrations completed and techniques refined. investigations will begin. Software for digital signal will be initiated.

5. (U) Program to Completion: This is a continuing program as methods of communications/electronics, IR and electro-optics become more sophisticated, the Army's electronic warfare equipment/systems must also advance/improve in order to effectively counter new threats. Conversely, as new and advanced EW techniques and systems evolve, better electronic counter-countermeasures techniques must be developed if the Army's electronic and weapons systems are to maintain their operational effectiveness in an electronic warfare environment.

6. (U) Major Milestones: Not Applicable.

7. Resources ($ in thousands):

Project: #A042 Title: Tactical Electronic Warfare Techniques

Program Element: #6.27.15.A Title: Tactical Electronic Warfare Technology

DOD Mission Area: #521 - Electronics and Physical Science (ED) Budget Activity: #1 - Technology Base

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	3150				Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	3322			Not Applicable	Continuing	Not Applicable

Decrease in FY79 is due to constrained Army resources. Decrease of $1466K in FY81 is due to budgetary constraints not anticipated in FY80 submission.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.16.A

Title: Human Factors Engineering in Systems Development

DoD Mission Area: #522 - Environmental and Life Sciences (ED)

Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5459	6741	7740	8151	Continuing	Not Applicable
AH70	Human Factors Engineering in System Development	5459	6741	7740	8151	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:

1. (U) User Problem: Improve US Army artillery system effectiveness in combat; increase US Army's ability to fight in built-up areas in Europe; improve individual soldier's personal equipment and its compatibility with all other items (weapons, gas mask, load carrying equipment, and armored vest); reduce noise damage to hearing among military personnel; improve performance of individual and crew-served weapon systems during periods of reduced visibility and smoke on the battlefield; improve development of visual displays for future Army air defense systems; reduce aircrew workload imposed by the introduction of new electronic displays, controls and data processing equipment into Army helicopters; improve ammunition resupply procedures.

2. (U) Objective: Human Factors Technology development must be conducted to furnish soldier-machine interface data to US Army Materiel Development and Readiness Command (DARCOM) Project and Product Managers in order to integrate that data into the design of the weapon system as early as possible to assure full weapon system effectiveness in the field.

3. (U) Products: This project guides the design, development, test and evaluation of Army materiel to make best use of soldier capabilities and avoid human limitations. Specific weapon systems benefiting from this program include: XM-1 Tank turret development, Black Hawk Helicopter equipment display, Artillery Battery Computer System, COPPERHEAD/155-mm Howitzer equipment employment, XM198 Self-Propelled Howitzer equipment employment, and artillery radar displays.

Program Element: #6.27.16.A Title: Human Factors Engineering in Systems Development

DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

4. (U) How used: Guidelines and procedures furnished DARCOM Project and Product Managers have guided the development of (1) a battery level computer for the Artillery Fire Direction Center, (2) the TOW Antitank Weapon System, (3) new infantry body armor and helmets, (4) one-handed flight control for helicopters, (5) fire control equipment for tanks, (6) ADP systems for conventional artillery, (7) mounting of anti-tank weapon systems on armored personnel vehicles, and (8) protection for ammunition handlers in combat loading the tank while under hostile fire. This program also directly impacts the development, design, test and evaluation of many other Army weapon systems.

C. (U) BASIC FOR FY 1981 RDTE REQUEST: Research will identify soldier/equipment shortcomings during Military Operations in Built-up Areas (MOBA). Field evaluation and testing of the effectiveness of equipment changes for operations in the MOBA environment will be accelerated. Other work will improve procedures to increase the accuracy and timeliness of artillery fire; reduce armored vehicle internal noise and thereby reduce hearing damage to the crew; seek means to improve soldier and crew performance in low visibility and smoke environments. This program will also attack problems of how to reduce time required to maintain equipment; how to improve air defense weapon system effectiveness by accelerating the human decision making process; how to improve soldier/equipment performance in hitting moving targets and how to improve the Army system of ammunition supply.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (Current Requirements)	5459	6741	7940	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	5922	6771	7247	Continuing	Not Applicable

In FY 1979 the Army withdrew funds from this program to fund higher priority requirements. The increase in FY 1981 reflects greater emphasis on soldier/equipment compatibility in Army materiel development. The FY 80 decrease reflects a general reduction by Congress.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.27.16.A Title: Human Factors Engineering in Systems Development

DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program is conducted by the U.S. Army Human Engineering Laboratory (HEL), Aberdeen Proving Ground, MD., which is a unique, central laboratory of the U.S. Army Materiel and Readiness Command (DARCOM), that provides research support to all of the DARCOM Commodity Commands and Project Managers in the technology area, Human Factors Engineering. Under this program, the Laboratory conducts fundamental and applied research, weapon system concept feasibility evaluation; system performance measurements; and provides human factors engineering application support on Army materiel items during development. The Laboratory operates a DoD-wide scientific data bank which includes data collected anywhere in the world in this technology field. This program, through research and field experiments, supports the development of small arms, infantry weapons, aviation, artillery, missile systems, communication and electronics equipment, combat vehicles, wheeled vehicles, clothing and personal equipment. The ultimate objective of this work is to assist in the development and production of the most effective and least expensive weapons and equipment for United States soldiers for combat anywhere in the world. Human factors engineering detachments or offices are located at major Army development activities, including the Project Manager for Training Devices (PM TRADES).

G. (U) RELATED ACTIVITIES: This Laboratory (HEL) is a leader in tri-Service coordination, e.g., under a tri-Service human factors technology coordination group. HEL chairs or participates in a helicopter human factors engineering sub-committee and a human factors test and evaluation sub-committee; assembles all appropriate data and publishes all tri-Service human factors engineering design standards and Human Factors Engineering Design Handbooks; chairs two NATO Research and Development committees and performs an independent human factors engineering review for all major Army materiel systems. Biomedical input into Army materiel design is coordinated through this program.

H. (U) WORK PERFORMED BY: In-house work is performed by the U.S. Army Human Engineering Laboratory, Aberdeen Proving Ground, MD., supported by USA Tank-Automotive Research and Development Command, USA Missile Command, and Communication Research and Development Command, and USA Armament Research and Development Command. Contractors with contracts exceeding $25,000 are: Falcon Research and Development Co., Denver, CO; General Electric Company, Pittsfield, MA; Georgia Tech Research Institute, Atlanta, GA; Advanced Technology, McLean, VA; San Jose State University Foundation, San Jose, CA; Andrulis Research Corp., Bethesda, MD; Food Machinery Corp., San Jose, CA; AAI Corp., Cockeysville, MD; and General Motors Corp., Goleta, CA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Conducted HELBAT 7 field exercise; data collected will have significant impact on defining concepts for artillery command and control systems, automation of artillery data handling, indirect fire semi-active laser seekers, integrated laying and fire control systems and target acquisition. A new mount for the DRAGON anti-tank weapon was

Program Element: #6.27.16.A Title: Human Factors Engineering in Systems Development

DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

developed and fabricated which significantly improves gunner performance and increases hit probabilities against moving and stationary targets. Determined changes needed in fit and sizing of male field clothing scaled down for female soldiers. Conducted assessment of new concepts of load bearing equipment for both male and female soldiers. Designed and fabricated an experimental idler wheel for tracked combat vehicles. It reduces noise inside the vehicle by 12 decibles without excessive heating or wear. Conducted over 1500 field trials on materials handling equipment under conditions representing the ammunition storage and handling activities of a Corps ammunition supply point in a combat environment.

2. (U) FY 1980 Program: Continue efforts to assess the effects of maneuvering and intermittent targets on gunnery performance as a function of major tank fire control system variables. Investigate improved Howitzer fire control, including defining criteria for the future enhanced self-propelled artillery system. Initiate human factors engineering research for digital fly-by-wire advanced flight controls project. Complete installation, checkout, and testing of the HEL in-flight validation system for helicopter pilots. Develop a plan, based on a building block approach, to measure the effectiveness of a combined arms team and initiate the first of a series of infantry systems tests. Conduct human factors engineering assessment of the squad automatic weapon system and the prototype combat vehicle crewman's helmet. As the lead laboratory for Military Operations in Built-up Areas (MOBA), update, coordinate and continue the MOBA program. An experimental low-noise sprocket wheel for track-laying vehicles will be developed and fabricated and evaluated, based upon the preliminary sprocket design and the advancements with the idler wheel. Determine principal human performance limitations in existing division air defense command, control and communications systems. Develop methodology, instrumentation and techniques to improve human performance in smoke/aerosol environment when using and not using night vision devices.

3. (U) FY 1981 Planned Program: Initiate a series of both simulated and live-firing studies, using the tank fire control research test bed and the scaled tactical armor range to assess operator performance as a function of selected basic fire control system parameters. Also, assess the degree of improvement that may realistically be expected from sophisticated new tank fire-control systems. Conduct HELBAT 8, an artillery combined arms study. Develop a program for human factors design criteria and guidelines for small arms design. Provide Human Factors Engineering criteria for the development of new generation CB protective clothing systems. Continue research related to Military Operations in Built-up Areas (MOBA), identifying information gaps and disseminating usable technical results to users. Experimental track-laying vehicle roadwheel will be designed, fabricated and tested. Direct experimental effort at reducing battalion/battery/company ammunition supply problems. Develop improved soldier-system interface designs using laboratory graphics terminal for air defense command, control and communications. Conduct field experiments to investigate the effects of degraded visual environment on infantry, artillery and armor units in terms of the ability to maintain geographical orientation with and without smoke and other obscuration.

Program Element: #6.27.16.A Title: Human Factors Engineering in Systems Development

DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program is conducted by the U.S. Army Human Engineering Laboratory (HEL), Aberdeen Proving Ground, MD., which is a unique, central laboratory of the U.S. Army Materiel and Readiness Command (DARCOM), that provides research support to all of the DARCOM Commodity Commands and Project Managers in the technology area, Human Factors Engineering. Under this program, the Laboratory conducts fundamental and applied research, weapon system concept feasibility evaluation; system performance measurements; and provides human factors engineering application support on Army materiel items during development. The Laboratory operates a DoD-wide scientific data bank which includes data collected anywhere in the world in this technology field. This program, through research and field experiments, supports the development of small arms, infantry weapons, aviation, artillery, missile systems, communication and electronics equipment, combat vehicles, wheeled vehicles, clothing and personal equipment. The ultimate objective of this work is to assist in the development and production of the most effective and least expensive weapons and equipment for United States soldiers for combat anywhere in the world. Human factors engineering detachments or offices are located at major Army development activities, including the Project Manager for Training Devices (PM TRADES).

G. (U) RELATED ACTIVITIES: This Laboratory (HEL) is a leader in tri-Service coordination, e.g., under a tri-Service human factors technology coordination group. HEL chairs or participates in a helicopter human factors engineering sub-committee and a human factors test and evaluation sub-committee; assembles all appropriate data and publishes all tri-Service human factors engineering design standards and Human Factors Engineering Design Handbooks; chairs two NATO Research and Development committees and performs an independent human factors engineering review for all major Army materiel systems. Biomedical input into Army materiel design is coordinated through this program.

H. (U) WORK PERFORMED BY: In-house work is performed by the U.S. Army Human Engineering Laboratory, Aberdeen Proving Ground, MD., supported by USA Tank-Automotive Research and Development Command, USA Missile Command, and Communication Research and Development Command, and USA Armament Research and Development Command. Contractors with contracts exceeding $25,000 are: Falcon Research and Development Co., Denver, CO; General Electric Company, Pittsfield, MA; Georgia Tech Research Institute, Atlanta, GA; Advanced Technology, McLean, VA; San Jose State University Foundation, San Jose, CA; Andruilis Research Corp., Bethesda, MD; Food Machinery Corp., San Jose, CA; AAI Corp., Cockeysville, MD; and General Motors Corp., Goleta, CA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Conducted HELBAT 7 field exercise; data collected will have significant impact on defining concepts for artillery command and control systems, automation of artillery data handling, indirect fire semi-active laser seekers, integrated laying and fire control systems and target acquisition. A new mount for the DRAGON anti-tank weapon was

Program Element: #6.27.16.A Title: Human Factors Engineering in Systems Development

DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

4. (U) FY 1982 Planned Program: Isolate the significant parameters of several simplified, quick response fire control systems which may enhance the performance of current and future US Army tanks when engaging evasive, battlefield type targets. Analyze the massive amount of data resulting from HELBAT 8 and publish results. Apply results of HELBAT 8 to design of new, more effective artillery components and/or total new artillery systems. Assess in-flight workload of Army helicopter crew members. Infantry systems test will investigate communications systems and other command control aspects in squad and platoon operations. Determine capabilities of new upcoming weapons/munitions systems in the MOBA environment. A prototype low-noise roadwheel for tracked vehicles will be tested. Investigate improved procedures for delivery of ammunition to firing units to include prototype equipment unpacking procedures and various vehicular delivery concepts. Develop standards for computer logic involved in military man-computer interactions. Investigate problem associated with military operations in built-up areas (MOBA) where smoke devices are likely to be deployed.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: 6.27.17.A
DoD Mission Area: 522 - Environmental and Life Sciences (ED)

Title: Human Performance Effectiveness and Simulation
Budget Activity: 1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2942	3383	3467	3482	Continuing	Not Applicable
A790	Human Performance Effectiveness and Simulation	2942	3383	3467	3482	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This element is concerned with the development of technology which will be used for the design of Army jobs, the development of job procedures and aids, the improvement of measurement of individual and unit readiness through the diagnosis of skill deficiencies, resulting in development of effective techniques for training and maintaining individual and unit skills. These developments are required to achieve effective operational capabilities in the face of decreasing quality and quantity of available personnel, increasing complexity and costs of acquiring and operating operational and training systems, decreased availability of training facilities, and the increased cost of using operational systems for training. If weapon systems are to achieve their designed capabilities, personnel available for operating and maintaining them must be trained to a high level of proficiency which must be retained under normal and wartime conditions.

C. (U) BASIS FOR FY 1981 REQUEST: The development of capabilities for analyzing the information needs of personnel in command and control systems and facilitating the operational integration of such systems; development of procedures for the timely integration of personnel and training subsystems; development of techniques which facilitate trading-off the processing, learning, and storage of information requirements of personnel and utilizing computers to assist in these functions; development of simulation systems for the training of air defense, field artillery and tank crews, infantry units and aviators; development of procedures for using operational tactical data systems for training purposes; development of improved assessment techniques for training applications, and the incorporation into training developments of improved training technology such as voice and videodisc technology.

Program Element: #6.27.17.A Title: Human Performance Effectiveness and Simulation
DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

RDTE	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
Funds (current requirements)	2942	3383	3467	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	3080	3733	4497	Continuing	Not Applicable

FY 1979 funding changes reflect congressional reductions. FY 1981 estimates reflect an Army decision to cancel the Armor Full Crew Research Simulator (AFCRS) which eliminates research planned in support of that simulator. The decrease in FY 80 reflects a reduction by Congress.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.17.A Title: Human Performance Effectiveness and Simulation
DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This element will devise simulation and other methods to assure individual and unit proficiency without the need for extensive maneuver and training areas. By providing procedures, job aids and job structures and through improved measures for assessing individual and unit readiness and diagnosing skill deficiencies, Army weapon systems will be operated and maintained as designed. This program provides the technological base for the development and improvement of: simulation techniques for training individuals and teams in rotary wing, armor, air defense, field artillery, infantry, and command and control systems; simulation and alternative techniques for training maintenance procedures; symbology and other aspects of presenting information in tactical command and control systems to facilitate decision making and evaluation of combat information; visual display requirements for training systems; work procedures and system design concepts for improved individual and team operations; improved integration of the personnel and training subsystems into emerging and revised weapon systems.

G. (U) RELATED ACTIVITIES: This research is coordinated with the Navy's 6.26.52N, Training and Human Engineering Technology, and with the Air Force's 6.22.05F, Training and Simulation Technology through means of DOD Topical Reviews, Training and Personnel Technology Conferences, Annual Budget and Apportionment Reviews, and participation in Tri-Service groups such as the Committee on Training, DOD/NASA Simulation Technology Coordination Panel, Helicopter Research Coordination Panel, Joint Technical Coordinating Group-Simulators and Training Devices, and the Technical Advisory Group for Maintenance Training. In addition, direct coordination is effected with pertinent service elements, such as the Air Force Human Resources Laboratory (AFHRL), Naval Personnel Research and Development Center (NPRDC), Army Project Manager for Training Devices (PM TRADE), Army Human Engineering Laboratory (HEL) and the Naval Training Equipment Center (NTEC) to cover related research in visual displays, training simulation, human factors in operational testing, aviation crew performance, and instructional technology. Data exchange among Army Research Institute, related Army agencies and other services is used to eliminate unnecessary duplication of research.

H. (U) WORK PERFORMED BY: Contractors include: Perceptronics, Inc., Woodland Hills, CA; Human Resources Research Organization, Alexandria, VA; WICAT Inc., Salt Lake City, UT; and Science Applications, Inc., McLean, VA. In-house work is performed by the US Army Research Institute for the Behavioral and Social Sciences and its field units distributed at major installations, including Ft Benning, GA; Ft Bliss, TX; Ft Knox, KY; Ft Leavenworth, KS; Ft Ord, CA; Ft Rucker, AL; Ft Sill, OK; Ft Benjamin Harrison, IN; and Germany.

Program Element: #6.27.17.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)
Title: Human Performance Effectiveness and Simulation
Budget Activity: #1 - Technology Base

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Job aids to the develop and complement instructional systems are in use in Army schools. Computerized training techniques for maintenance troubleshooting were developed and are now being used in related advanced technology research. Procedures for the use of an operational tactical fire direction system (TACFIRE) for skill training and assessment were evaluated and implemented. Methodologies for simulating the interaction of personnel and machines or systems were developed and applied to the Tactical Operations System. Techniques were developed for analyzing tactical intelligence decision process. Computer generated display symbology for command and control systems have improved operator performance by 35 percent. The Multiple Integrated Laser Engagement System (MILES) for combat training was developed and tested; the MILES system will be the Army's principle means for combat simulation. The effectiveness of light-attenuating goggles for simulating night training during daylight hours has demonstrated a 50 percent reduction in training time. Simulator display requirements for training rotary-wing pilots was developed for use at Fort Rucker, Alabama. Prototype training programs developed for the Army's UH-1 helicopter flight training simulator reduced flight hours needed by 40 percent.

2. (U) FY 1980 Program: Develop methods for simulating human performance in command and control system. Formulate methods to improve the utilization of human factors information for automated battlefield system development. Develop specifications for applying computer-assisted instructional techniques in an operational tactical fire direction system (TACFIRE). Develop handbook for the use of Army training developers in defining training device requirements and characteristics. Develop methodology for predicting battlefield events through the use of computer based graphic displays. Evaluate the concept of using operational system computer capabilities to test the skills of systems personnel (i.e., Skill Qualification Test). Develop prototype training device test plans and analyze the training management system for the XM1 tank. Determine the training effectiveness and most appropriate skill requirements of tank gunnery devices. Develop grading and evaluation material for Army aviation instructor pilots. Evaluate methods of instruction for range estimation and target identification training of Aeroscout helicopter pilots engaged in target acquisition. Initiate and develop a videodisc technology system for use in training.

Program Element: #6.27.17.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Human Performance Effectiveness and Simulation
Budget activity: #1 - Technology Base

3. (U) FY 1981 Planned Program: Analyze soldier performance in complex battlefield automated systems to extract discriminants of overall group performance. Develop a prototype training program for using memory aids. Evaluate selected methods of instruction in target range estimation and identification for Aeroscout helicopter pilots. Develop human factors design guidelines for utilization of information data bases with battlefield automated systems. Develop procedures to reduce the error rates in the command and control of field artillery systems. Expand the concept of using an operational system for Skill Qualification Testing to include adaptive testing. Initiate the study of feasibility of an aviation training research facility. Assess the utilization tradeoffs of videodisc technology for the delivery of training extension course materials and skill qualification testing. Develop an automated planning aid for determining command group training strategies. Develop procedures to transform information about tasks requirements data into system design characteristics and training equipment requirements. A total of 46 professional and 25 support personnel are involved in this effort.

4. (U) FY 1982 Planned Program: Continue research into relating of soldier performance data issues to the readiness of battlefield automated communications, command and control, and information systems. Continue exploring innovative approaches to maintenance training. Develop improved display and information processing techniques for tactical operations systems. Develop improved methodologies for the field evaluation of operational and training system performance. Develop standardized units of behavior to facilitate the structuring of jobs and training programs to be more compatible. Improve combat simulation-based training and evaluation techniques. Develop procedures for the development of training programs which are responsive to the results of adaptive testing programs. Refine procedures for estimating training requirements early in the development of emerging weapons systems.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.19.A
DOD Mission Area: #523 - Engineering Technology (ED)

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

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5011	4912	6079	6148	Continuing	Not Applicable
AT40	Mobility and Weapons Effects Technology	5011	4912	6079	6148	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The potential for fighting a numerically superior, modern mechanized opponent in a European environment requires that the effectiveness of the combat engineer be significantly increased. Exploratory development in military engineering for the effective employment and suvivability of the Army's sophisticated weapons systems can be achieved through: (1) ground mobility/countermobility technology that exploits the best killing characteristics of our new weapons and insures that battlefield terrain is used effectively as a force multiplier; (2) techniques for rapid repair of battle damaged facilities and construction in support of combat and logistical elements in the theater of operations; (3) a knowledge of weapons effects and the response of protective structures to nuclear and conventional munitions for increased battlefield survivability and more effective targeting techniques; (4) techniques for passive counter-surveillance as a cost effective technology for increasing the survivability of fixed installations supporting combat operations.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Improved criteria for predicting the effects of nuclear and conventional weapons will be developed to provide maneuver forces increased strike options during combat operations. Methods and criteria for using bulk and conventional explosives as a non-nuclear option in barrier and denial operations will be developed. Technology for standoff location of minefields and new techniques that will enable the combat soldier to easily neutralize mines will be developed. A computerized weapons effects information and analysis system will be made available to the Department of Defense and other users. Weapons protection criteria and techniques will be developed for the field Army's repair parts computer system housed in mobile vans, underground hardened facilities supporting critical Command, Control and Communications functions, and troops and equipment engaged in urban warfare. Methods will be perfected to predict single vehicle performance in partially frozen ground and combat vehicle movement rates through urban areas in support of high mobility combat vehicle development, and as input to intelligence preparation of the battlefield. Methods for predicting the impact of hydrological data in the field and its effect on combat operations will be developed and a computer code to analyze installation passive countersurveillance needs will be made operational.

Program Element: #6.27.19.A
DOD Mission Area: #523 - Engineering Technology (ED)

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

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5011	5150	6051	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	4915	5150	5269	Continuing	Not Applicable

The increase of $96 in FY 1979 resulted from funding research efforts in developing stream flow forecast capability supporting the intelligence preparation of the battlefield. The decrease of $238 in FY 1980 results from a mandate from Congress to decrease the amounts paid as overtime. The increase of $810 in FY 1981 results from funding requirements of high priority Department of the Army projects responding to increased emphasis in combat engineering, mobility and survivability in urban areas.

E. (U) OTHER APPROPRIATION FUNDS: *Not Applicable*

Program Element: #6.27.19.A Title: Mobility & Weapons Effects Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Research is conducted in the areas of weapons effects, combat engineering, base development in the theater of operations, military hydrology, and construction technology for military facilities. Specific objectives are: to provide the Army a capability to predict the effects and response of military targets to nuclear and non-nuclear munitions; to develop design and operational criteria for field fortifications; to develop design criteria and construction techniques for underground hardened facilities; to develop, improve, and apply engineering technology for military road and airfield systems, lines of communication and base facilities, and logistics over-the shore operations; to develop ground mobility techniques that assure terrain is used to maximum advantage; and to develop techniques and criteria for determining the physical properties and response of earth materials important to combat engineering and military construction activities supporting combat operations.

G. (U) RELATED ACTIVITIES: Program Element 6.11.02.A, Mobility & Weapons Effects Technology, Project AT22, Research in Soil and Rock Mechanics. Formal coordination of related mission-oriented research by the Navy, Air Force, Defense Nuclear Agency, Department of Interior, Department of Transportation, and The Department of Energy is conducted through annual technical reviews, the Joint Services Civil Engineering Research and Development Coordinationg Group and joint interagency activities. Informal coordination is conducted through frequent individual contracts. Coordination precludes duplication of effort.

H. (U) WORK PERFORMED BY: Approximately 88 percent of the work is performed in-house. The US Army Engineer Waterways Experiment Station, Vicksbug, MS, serves as the managing laboratory and is the primary performing activity. A portion of the work in the weapons effects is performed by the US Army Construction Engineering Research Laboratory, Champaign, IL. Contractors are selected through Requests for Proposals.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: A report was prepared on techniques to create barriers and fighting positions with slurry explosives in support of armor and anti-armor operations. The weapons effects information and analysis system was updated to include improved airblast and cratering ejecta models and expanded by the development of a ground shock model. Design criteria for cables and conduits connecting buried hardened structures to withstand ground shock was developed. Revised prediction data for the influence of a shallow water table on explosive cratering was developed. Tests were conducted and a hardness assessment model was developed to model the effects of conventional weapons on typical European buildings and structures in urban warfare. The single vehicle gap crossing performance prediction model was upgraded. The computerized mobility - oriented terrain data base was upgraded and ground data was obtained in the West German Fluda and Lauterback regions. A criteria for rapid construction of approach roads to tactical bridges through the use of a grid soil confining system has been developed. Reports were published on a structural design procedure for rigid airport pavements and on a rigid pavement joint design model for airfield pavement analysis. A plan has been developed for a cooperative test with NATO countries for techniques for passive

counter- surveillance of fixed installations from thermal sensors. A concept for repairing and rehabilitating roads and storage areas and constructing expedient surfaces adverse weather conditions using sand filled membranes was developed. Safe criteria for breaching walls with small charges were developed. A computer program for constructing a geologic profile in any direction from a bore hole was verified. A design concept for a preemplaced complex of fighting positions that will be able to survive a long-term high intensity artillery barrage was developed.

2. (U) FY 1980 Program: Criteria for predicting breaching of concrete dams by nuclear explosives will be formulated. Development of techniques for creating tank, artillery and troop fighting positions and to assist in gap crossing operations using binary blasing agents will be finalized. A user's manual for the computerized weapons effect information and analysis system will be prepared and distributed to users. Design criteria will be developed for shielding conduit systems in hardened facilities from electromagnetic radiation generated by nuclear blast. Methods for predicting damge to targets such as bridges and POL tanks from low-yield nuclear surface bursts will be developed. Procedures for breaching and demolishing urban buildings and utility tunnels with engineer munitions will be developed. A durable material for training village construction will be developed to absorb impacting projectiles and bomb fragments. A method of predicting single vehicle performance in partially frozen ground will be developed for use as a submodel in the overall mobility terrain analysis procedure. A first generation computational system for converting conventional terrain data into more detailed mobility-terrain data will be finalized and released to users for field trials. A preliminary model to predict vehicle movement rates through urban areas will be developed. Cost effective techniques for fixed installation passive countersurveillance will be developed and current shortfalls identified. Concepts, construction guidelines, and recommended materials and protection methods for construction of soil strengthened structures will be finalized. Current technologies and operational procedures to update the Army's hydrologic capability will be defined and provided to field units in the form of field manuals, and training courses. An improved military pavement deterioration analysis system will be fomulated. Procedures for the analysis and design of foundations constructed on expansive soils will be finalized.

3. (U) FY 1981 Planned Program: An improved computer code for asessing the hardness or vulnerability of strategic facilities will be developed. The user's manual for the computerized weapons effects information and analysis system will be finalized and distributed. Procedures for producing demolition charge cavities in rock by explosive methods will be formulated. Criteria for the design, and construction of earth-covered fiberglass ammunition storage bunkers will be formalized. Criteria for determining the survivability of troops and equipment in urban buildings used as fighting positions will be formulated. Procedures for creating obstacles and demolishing buildings in urban areas using engineer munitions will be developed. Design criteria and construction techniques for a mock village to support troop training in urban warfare will be finalized. Improved terrain/mobility submodels for predicting the linear feature and gap-crossing capabilities of ground vehicles will be developed. Procedures for enhancing beach trafficability using grids, fabrics, and membranes to confine sand will be finalized. Potential materials and procedures for rapid repair and restoration of bomb-damaged pavements will be evaluated. Improved methods for predicting rock behavior around tunnel and for supporting such openings will be formulated. Criteria for evaluating the effects

of piling skin friction on pier performance in cohesive soils will be developed. Improved surfacing materials to withstand traffic from tracked vehicles will be developed for use at Army training installations. Design and construction criteria for recycling existing pavement materials for pavements rehabilitation will be finalized.

4. (U) FY 1982 Planned Program: Design concepts will be formulated for protecting artillery emplacements from damage by conventional weapons. A minefield design and deployment simulation model will be developed. Design criteria will be developed to provide fixed installations with countersurveillance techniques for thermal sensing. The concept for development of an air-delivered rapid runway repair kit will be finalized. Field tests of projectile explosions above, within, and below shield slabs will be conducted to determine the influence of blast waves on buried structures. The levels of degradation of Warsaw Pact POL distribution systems from given US weapon systems will be determined. Tests of explosive systems in soils, rock and man-made materials for rapid emplacement and hole excavation for ADM emplacement will be conducted. Reliability criteria will be developed to account for material and loading variability for use in life-cycle management of pavement systems. A first-generation model for predicting vehicle movement through simular sections of urban areas will be developed. Field tests with recovery vehicles to establish recovery times for evacuating immobilized vehicles will be conducted. Earth moving tests with explosives to bridge dry gaps for mobility crossings will be conducted. Procedures for selective demolition of urban buildings will be developed. The results of demolition tests on model strees with engineer munitions to develop criteria for barrier creation in urban areas will be evaluated.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.20.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Environmental Quality Technology
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	9613	9465	10165	10497	Continuing	Not Applicable
D048	Environmental Quality Research Development	2892	3590	3765	3925	Continuing	Not Applicable
A835	Identification & Health Effects of Military Pollutants	3886	3519	3693	3783	Continuing	Not Applicable
A896	Environmental Quality for Construction & Operation of Military Facilities	2835	2356	2707	2789	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Federal, state and local regulations require that the Army minimize the impact of its peacetime operations on the environment. This program element provides the exploratory development support to the Army's program for compliance with these regulations. The major program thrust is to provide the technology base necessary to enable the Army to meet 1984 time frame and beyond pollution abatement requirements. The program element consists of three projects: Project A835 efforts are performed by the Surgeon General; this project is concerned with the development of toxicological data on Army unique pollutants for use in establishing safe environmental effect levels to support development of pollution control and monitoring technology. Project D048 efforts are performed by the US Army Materiel Development & Readiness Command (DARCOM) and are aimed at developing pollution abatement, treatment and recovery methods for Army ammunition plants, arsenals and depots. Project A896 efforts are performed by the Chief of Engineers; this project develops pollution abatement, impact assessment and resource management methods for Army installations. The program is responsive to the science and technology objectives for environmental quality contained in the Army Science & Technology Objectives Guide (STOG).

C. (U) BASIS FOR FY 1981 RDTE REQUEST: The funds requested for FY 1981 will permit development and evaluation of technology for meeting 1984 time frame munitions waste pollution abatement requirements; a major increase in efforts on toxicity of Army unique

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DOD Mission Area: #522 - Environmental and Life Sciences (ED)

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pollutants to support compliance with the Resource Conservation and Recovery Act and the Toxic Substances Control Act; and efforts to provide new management, assessment and abatement methods and systems to enable military installations to comply with state enforced pollution control requirements.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE					
Funds (Current Requirements)	9613	9465	10165	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	9448	9675	9411	Continuing	Not Applicable

The increase of $754K in the Program Element between the FY 1980 and FY 1981 budget request for FY 1981 reflects the increased research requirements imposed by the need for Army compliance with the Resource Recovery and Conservation Act and Toxic Substances Control Act. The $165K increase in FY 1979 actual over the FY 1980 estimate results from increased effort in environmental and health effects research on smokes and obscurants. The decrease of $210K in the FY 1981 from the FY 1980 request results from a general congressional reduction.

F. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.20.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Environmental Quality Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Program was inititated 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 need to achieve compliance with pollution abatement and environmental enhancement requirements for its industrial plant and military installation operations. The technical thrust areas of the program 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 developing information data bases for effectively performing management and planning functions with appropriate consideration of environmental protection and enhancement; Source Reduction, Control and Treatment 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.

G. (U) RELATED ACTIVITIES: Projects AH68 (Processes in Pollution Abatement Technology) and BS04 (Identification and Health Effects of Military Pollutants) in Program Element 6.11.02.A, Defense Research Sciences, comprise the basic research portion of the Army Environmental Quality Technology Base Program. Project AH68 is concerned with gaining an understanding of the fundamental chemical/physical processes that occur during treatment/disposal of munitions wasts; Project BS04 is concerned with investigating the feasibility of developing less costly and time consuming methods for conducting toxicology studies. Other related Program Elements include 6.27.04.A, Military Environmental Criteria Development, which provides technology base support to the Army Installation Restoration Program and 6.27.77.A, Systems Health Hazard Prevention Technology, Project A878, Health Hazards of Military Materiel. Project A878 addresses occupational health research program of the Surgeon General. Program Element 6.27.20 provides technology transfer to the pollution abatement activities being accomplished in 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 interest, joint efforts are undertaken or a service may adopt the results of anothers' 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. Semi-annu meetings of the Joint Services Civil Engineering Research & Development Coordination Group (JSCERDCG) 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. Inter-Service coordination occurs routinely at the technical level on joint programs and technical efforts of mutual interest. Other federal agencies pursue environmental quality research programs related to their roles in the federal government these are: The Environmental Protection Agency (EPA), Department of Health, Education and Welfare (HEW), Department of 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. Joint programs are undertaken in areas of common interest.

Program Element: #6.27.20.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Environmental Quality Technology
Budget Activity: #1 - Technology Base

H. (U) WORK PERFORMED BY: Approximately 49% of the research effort is performed in-house by the US 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; US Army Medical Bioengineering Research Laboratory, Fort Detrick, MD; US Army Construction Engineering Research Laboratory, Champaign, IL; US Army Waterways Experiement Station, Vicksburg, MS; and US Army Cold Regions Research and Engineering Laboratory, Hanover, NH. Major contractors include: SRI International, Menlo Park, CA; Hercules Inc. Redford, VA; Midwest Research Institute, Kansas City, MO; University of Illinois, Urbana, IL; Mitre Corporation, McLean, VA; A.D. Little Co, Acorn Park, MA; Medical College of Virginia, Richmond, VA; the Ohio State University Research Foundation, Columbus OH.; Forecasting International LTD Arlington, VA and York Research Corporation, Stanford, CT.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Program objectives and priorities were formalized in FY 1977 in the Army Science and Technology Objectives Guide (STOG). Science and Technology objectives for the environmental quality technology program address the need for improvement 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 include: 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 munition plant waste water. A surfacant treatment method for munition plant wastewater was developed yielding an environmentally acceptable discharge. High nitrate in munition plant waste waters was shown to be reduced by a fluidized bed biodenitrification process. Methods were developed to regenerate the carbon for reuse in charcoal filtration of munition plant waste water. Instruments were fabricated and tested to measure acid mists in air and to measure certain organic chemical effects in waste water. A process for treatment of "red water" waste from TNT manufacture was selected as best available technology for implementation at appropriate Army ammunition plants. Design criteria was developed to enable Army sewage plants to comply with new National Pollutant Discharge Elimination System (NPDES) permits. The Environmental Technical Information System (ETIS) was developed to aid installations prepare environmental impact assessments and statements required by the National Environmental Policy Act (NEPA). A computer program enabling prediction of blast and helicopter noise impact on communities was developed.

2. (U) FY 1980 Program: Testing of a redesigned TNT purification process is being continued to evaluate the economics and the decrease in pollution achieved by the process in the manufacture of TNT. Development and evaluation of processes for abatement of

Program Element: #6.27.20.A
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munition plant waste streams is continuing to identify cost effective processes suitable for implementation at specific sites. Studies are continuing on the use of High Pressure Liquid Chromatography, specific ion electrodes and other techniques for rapid detection of pollutants in military waste streams. Characterization and mammalian toxicology studies of critical air pollutants from munitions plants have been initiated. Mammalian toxicology studies are continuing on TNT, RDX and primers. Initial hazard of assessment of battlefield smokes and obscurants are being completed. Development of computer software for noise impact prediction of Army unique vehicles, rockets and fixed noise sources such as rocket launch sites and engine test stands is underway. Final design guidance on the use of the rotating biological contractor is in preparation. Characteristics are being developed for environmentally safe design and siting of Army sanitary landfills.

3. (U) FY 1981 Planned Program: Efforts will be continued to complete development and selection of the best available technology for abatement of waste streams from Army munition plants and depots. Studies will be completed on landfill disposal of sludges from sulfide precipitation of electroplating wastes. Studies will be performed on munitions manufacturing processes to optimize water reuse while meeting effluent discharge guidelines. Physical treatment methods such as catalytic flocculation, coagulation/oxidation, surfactant separation and sulfide precipitation will be evaluated for application to munition and depot waste streams. In environmental and health criteria development, emphasis will be on criteria development for water and air pollutants related to the manufacture of new smokes/obscurants, munitions wastes from new or modified manufacturing and/or treatment processes, and toxic/hazardous wastes unique to the Army. Expanded studies to determine what happens to waste compounds in the environment will be an important part of criteria development, along with continuing chronic mammalian toxicology studies and aquatic bioassays of Army unique waste compounds. Development, integration and validation of software programs for noise impact prediction will be continued; additional noise sources investigated will include industrial plants. Studies will be undertaken to develop methods for noise mitigation for operational and training buildings. Criteria for solid waste management, recycle and resource recovery at Army installations will be completed. The in-house personnel required to support the program includes 115 professional and 38 support.

4. (U) FY 1982 Planned Program: Development and evaluation of chemical, physical and biological processes for pollution abatement will be continued to identify cost effective methods for application to Army industrial facilities on a site specific basis. Design criteria for selected processes will be submitted for project definition under Military Construction Appropriations (MCA). Priority efforts will continue to be placed on definition of environmental effect levels for smokes, obscurants and other Army unique hazardous and toxic materials. Support to Army installations in responding to state and local requirements for pollution control will be continued by development of software systems to aid management of pollution abatement operations, to improve predictive and analytical capabilities for assessing environmental impacts of Army activities and by developing unique processes for cost effective abatement of installation waste streams.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.22.A
Title: Manpower Personnel and Training
DoD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5934	5418	5462	5486	Continuing	Not Applicable
A791	Manpower Personnel and Training	5934	5418	5462	5486	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The volunteer Army today is faced with a dual manning problem: reduced supply in both numbers and capabilities for complex technical jobs, and increased demands for high technology skills. This program has five key research approaches to the problem: (1) Designing of weapons systems and the related organization structure required to keep the demand for special skills at a feasible recruiting level, (2) Relating personnel requirements to a "census-map" of resources, (3) Developing approaches which will help increase the supply of applicants by new recruitment selection and assignment strategies, (4) Design and development of new training programs for continuing individual soldier skill development and related unit readiness and (5) Developing methods which will promote retention, commitment to service, and unit cohesion while sustaining high performance in Army units.

C. (U) BASIS FOR FY 1981 REQUEST: Increased research effort is needed in (1) improved methods to more accurately predict human capabilities in the available population and to adjust human requirements for new weapons systems accordingly, (2) development of new recruitment, accession, and assignment systems to make maximum use of available talent and resources, (3) design of training programs to develop skills to meet the pace and level of individual abilities, with emphasis on continued skill enhancement and team/unit skill development in operating units, and (4) development of methods to improve integration of the soldier with his unit, to increase unit cohesion and improve mission readiness.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5934	5418	5462	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	4786	5918	6594	Continuing	Not Applicable

Program Element: #6.27.22.A Title: Manpower Personnel and Training
DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

Funding changes in FY 79 reflect program restructuring to help solve critical Army manpower shortage. The FY 1981 reductions reflect Department of Defense overall reduction to eliminate planned increases for inflation and increased salary costs. The FY 1980 decrease reflects a $500 thousand reduction by Congress.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.22.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)

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

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Current field and laboratory research thrusts are a part of the Education and Training and Manpower and Personnel Management categories and are focused on problems associated with (1) manning the force, (2) training for combat readiness, and (3) organizational cohesion and effectiveness. In the first thrust area, research provides methods to estimate talent resources in the available youth manpower pool; how to motivate, train, support and evaluate recruiters; new assessment processes for Army leaders and key combat arms enlisted personnel; and support of the Army's Officer and Enlisted Personnel Management Systems, needed for retention and manning of a quality career force. New efforts are developing methods for determining, and trading-off personnel performance requirements and human capacities for alternative designs of new weapons systems, and the automation of a system to assess, select, and allocate soldiers for training and unit assignment. Training research currently provides methods for performance-based "hands-on" skill development and evaluation. New efforts are directed towards development of training programs and training management systems, employing computer-interactive technology. Such programs enable individuals to proceed at their own pace and reach their maximum skill level by the use of integrated training "packages" in both residential and non-residential courses. The goal is a continuing development of individual skills on the job in conjunction with attaining a high level of collective skills in teams and units. Current research to support organizational cohesion and effectiveness provides a basis for assessing the state of readiness in military units in terms of leadership effectiveness and communication between levels, in relation to measures of motivation, command climate, discipline and command effectiveness. New effort is directed to relating leadership, communications, and measures of soldier commitment to results in actual unit training and performance in simulated combat situations.

G. (U) RELATED ACTIVITIES: This effort is coordinated with Air Force Personnel Utilization Technology, P.E. 6.26.03F; Navy Personnel Support Technology, P.E. 6.27.63.N; Education and Training, P.E. 6.36.43.A; Training and Simulation Technology, P.E. 6.22.05.F. Interservice coordination is assured through Department of Defense sponsored topical reviews, annual budget and apportionment reviews, tri-Service participation in preparation of Technology Coordinating Papers and Technical Advisory Groups (TAG) in such areas as selection and assignment techniques, leadership development, and technical training. This includes both coordination of efforts and avoidance of unnecessary duplication of effort.

H. (U) WORK PERFORMED BY: Contractors include: Lawrence Johnson Associates, Washington, DC; McFann Gray Associates, Carmel, CA; Discover Foundation, Inc., Westminster, MD; Litton Systems, Inc., Sunnyville, CA; Center for Management Organizations, University of South Carolina, Columbia, SC; Human Resources Research Organization, Alexandria, VA; Perceptronics, Woodland Hills, CA. More than half of the funds expended for contracts are for competitive procurements. In-house work is performed by the US Army Research Institute for the Behavioral and Social Sciences and its field units distributed at major installations, including Ft Benning, GA; Ft Bliss, TX; Ft Knox, KY; Ft Leavenworth, KS; Ft Ord, CA; Ft Rucker, AL; Ft Sill, OK; Ft Benjamin Harrison, IN; and Germany.

Program Element: #6.27.22.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)

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

1. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Past research has produced an information data base on enlisted performance and first-tour retention factors in the first five years of the volunteer force. Initial findings have shown that tactical battalion command groups which effectively use organizational management skills completed assigned missions in less time and with lower casualties. Methods to improve training evaluation programs, and the Soldier's Manuals in the Battalion Training Management System, have been developed and are being applied. Techniques for crew training and cross-training in Armor units resulted in a 20 percent increase in target gunnery performance. A taxonomy for training scenarios for advanced air defense weapons systems is now being evaluated at the Air Defense School. New on-the-job self-paced training techniques for selected combat and support skills were developed and are being tested.

2. (U) FY 1980 Program: Develop methods to determine human skill requirements in relation to automated equipment capabilities in the early design of new Army systems. Develop and test strategies to integrate individual and collective training, and incorporate these into a prototype training management system for operational units. Apply systems analysis techniques to crew and platoon functions in combat units as a basis for training and maintaining readiness. Determine effects of personnel turnover on team and unit performance, and develop methods to counter such effects, particularly in high technology, quick response units (e.g. in Europe). Develop programs for orientation of junior enlisted personnel to the Army during training and initial assignment. Investigate new training methods to enhance skill retention and transfer, with particular emphasis on combat and equipment maintenance jobs. Develop new programs in NCO leadership training and senior command management competence.

3. (U) FY 1981 Planned Program: Develop procedures to institutionalize improved methods of projecting manning and skill maintenance requirements in the weapons system acquisition process. Develop new modes of assessing recruit potential in order to increase the usability of available personnel. Develop training management systems maximizing the use of educational technology and self-paced skill acquisition and maintenance. Conduct follow-up analyses of enlisted input to determine the effects of training processes and experience in units on soldier performance, retention, and reenlistment. Field-validate methods and techniques to counter effects of personnel turnover on crew and unit performance. Design measures of effectiveness for prototype personnel management simulation models. Apply strategies of integrating individual and collective training to the specific conditions in each of the combat arms. Develop methods to utilize computer technology for generation of training scenarios, and feedback of skill qualification test results. Design methods for simulating complex military organizations and applying systems theory to organizational design, restructuring, and management. A total of 62 professional and 30 support personnel are involved in this effort.

Program Element: #6.27.22.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)

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

4. (U) FY 1982 Planned Program: Continue development of an integrated model for the acquisition of new Army systems in which tradeoff options between human and automated capabilities are identified and resolved during hardware design and development. Apply talent resource census information to Army recruiting and investigate the situational factors influencing volunteering for service. Develop and test methods for selection, training, and assignment of teams and small units or subunits from entry into service, and develop personnel allocations models for alternate replacement policies. Develop simulation-based methods for training senior leaders in the employment of highly complex military staff organizations under battlefield conditions where there is great time pressure and environmental uncertainty. Develop methodology for assessing and improving those aspects of military cohesiveness found to be significantly related to indicators of unit performance and mission readiness.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.23.A
Title: Clothing, Equipment, and Shelter Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3797	4394	6837	5272	Continuing	Not Applicable
A098	Clothing and Equipment Technology	3432	3292	5895	4233	Continuing	Not Applicable
A427	Tactical Rigid Wall Shelters	365	1102	942	1039	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Exploratory Development (ED) efforts in this program are oriented to improving combat clothing, individual equipage, field service support equipment, and shelters in order to significantly increase the soldier's effectiveness and provide protection for him/her 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 thermal resistance. Modern camouflage must decrease the probability of detection. New synthetic fibers with additional protective capabilities and new dyes and weave patterns can be expected to provide passive defensive protection against many modes of enemy surveillance. For combat vehicle crewmen to survive, ten seconds protection is needed to allow escape from burning vehicles such as tanks; modern fabrics hold promise of meeting this need. ED in tactical rigid-wall shelters is part of a Department of Defense effort to meet International Organization for Standardization (ISO) specifications and, at the same time, reduce the proliferation of tactical shelters and special-purpose vans. ED in tentage is to attain the capability: to design field shelters which are more habitable, more fully meet field-operational requirements; and reduce the logistical support and financial investment required for current field shelters. Work on organizational field service equipment is pointed toward decreasing the cost of operation while improving efficiency.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: To conduct research pertaining to the development and improvement of fibers, fabrics, materials, new design applications, camouflage (dyes and technology) for clothing, personal equipment and field service support equipment to increase the survivability of the combat soldier on the battlefield against projected threats. To conduct research to insure that these new materials and combinations of materials exhibit superior performance in the face of

Program Element: #6.27.23.A
DOE Mission Area: #522 - Environmental and Life Sciences (ED)

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

operational threats (ballistic, chemical agent, flame, and thermal/infrared detection), as well as environmental conditions (extreme cold, extreme heat, rain, physiological stress). A greatly expanded program of research on fibers/fabrics for chemical/biological (CB) clothing will be initiated with the aim of developing a new lighter-weight and air-permeable material which still prevents the passage of toxic agents.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	3798	4394	6837	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	3450	4397	7219	Continuing	Not Applicable

Decrease in funding in FY 1981 represents refinement of estimates in both Projects A1198, Clothing of Equipment Technology and A427, Tactical Rigid-Wall Shelters. Additional funds were added in FY 1979 to increase efforts on microbial deterioration and contamination of materials. The FY 1980 decrease is the result of a general Congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.23.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

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

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program is designed to improve 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 detection by 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 efforts to improve field service equipment, field life support facilities, tactical rigid-wall shelters, and the development of design criteria for field shelters.

G. (U) RELATED ACTIVITIES: In order to preclude a duplication of effort, related research is 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 Program Element (PE) 6.37.47.A, Soldier Support/Survivability, and to Engineering Development (ED) under PE 6.47.13.A, Combat Feeding, Clothing and Equipment. AD in tactical rigid-wall shelters is performed in PE 6.37.26.A, Combat Support Equipment, Project D428, Tactical Rigid-Wall Shelters. Engineering Development is conducted in PE 6.47.17.A, General Combat Support, Project D429, Tactical Rigid-Wall Shelters.

H. (U) WORK PERFORMED BY: The major in-house effort is performed by the US Army Natick Research and Development Command, Natick, MA. Other Government activities involved are US Army Aeromedical Research Laboratory, Ft Rucker, AL; US Army Materials and Mechanic Research Laboratory, Watertown, MA; and US Army Chemical Systems Laboratory, Aberdeen Proving Ground, MD. Known contractors are Libby Company, Lewiston, ME; Rohm and Haas Company, Springhouse, PA; Kimberly Clark, Lee, MA; FRL Corporation, Dedham, MA; Union Carbide Company, Cleveland, OH; North Carolina State University, Raleigh, NC for contracts worth $430,000. There are nineteen (19) other contracts worth $1,377,000.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: A psychophysical study of the factors that relate to the design of camouflage patterns was completed and published. A series of reports on the anthropometry of the women of the US Army was completed and published. Fitting and sizing study for women of field trousers and liner, leather gloves and insert, helmet liner cap, and chemical/biological (CB) ensemble were conducted. Study of mental and psychomotor performance of men under high temperature and humidity was conducted, and a similar study was initiated for women. Processes and methods to obtain carbon laminated or impregnated materials with optimum CB protection were evaluated. Also, the possibility of combining CB protection with flame resistance was investigated, and several flame retardant finishes were tested on the standard overgarment material. Filters

Program Element: #6.27.23.A
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Title: Clothing, Equipment, and Shelter Technology
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with a range of spectral and transmission characteristcs designed to provide optimum eye protection when used with specific photochromic dye systems were obtained. An experimental test method was developed to impact individual textile yarns ballistically and to measure the material reaction in quantitative units of stress, strain, and time. Computerized colorant programs (pigment and dye) were validated and are now used routinely. Development of a statistical method to evaluate results of a fabric color-matching experiment was completed. A new effort was initiated to study the response of materials to noise and overpressure. Analytical work on the 3-for-1 expandable shelter continued; work began on the response of these structures to dynamic landings/forces and the use of models developed to answer questions concerning the suitability of design changes. Six commercial non-destructive test devices for finding debonding in honeycomb panels have been obtained and are undergoing evaluation and laboratory testing to determine their suitability. Experimental studies of the influence of thermal loading on the skin-core delamination problem in honeycomb panels have also been started. Work was initiated on: solving the nuclear, chemical, biological (NBC) ballistic threat for tactical shelters based on a review of the nuclear environment in which these shelters must be operated, and preparation of computer codes for the structural analysis of these shelters in this environment.

2. (U) FY 1980 Program: In area of Exploratory Development (ED) on fibers/fabrics for chemical/biological (CB) protective ensembles, exploit the potential of wet-laid nonwoven materials containing activated carbon. Initiate a study of dry-laid nonwoven materials with an activated carbon ingredient for CB applications. Evaluate chemical protective materials to determine sorptivity, surface area, textile, and physiological properties. Investigate improved charcoal binders, formations and materials for CB application. Investigate feasibility of preparing activated carbon from pitch using continuous process. Continue compounding of butyl phophazene rubber fabricated into molded or dipped sheets and coated fabrics. Conduct feasibility study on use of wrapped carbon yarns, crushed foam, and spun-bonded/melt-blown webs for chemical protective properties. Study effects of atmospheric conditions on carbon impregnated materials. Use new concepts to employ advanced insulating materials in cold weather clothing. Complete design and fabrication of a radar absorbant material. Investigate woven and nonwoven fabrics for camouflage in snow-covered terrains, and develop concepts to improve camouflage of shelters in conventional tactical employments. Prepare collation of all available anthropometric data on women, both military and civilian. Anthropometric data will be analyzed to provide basis for development of integrated sizing system for field clothing pattern. Fitting/sizing study will be conducted on standard flight coveralls when worn by female personnel. Evaluation on men's cold-wet and cold-dry clothing components for female use will continue. Bio-mechanical analysis on males/females using modified load-carrying equipment will be conducted. Initiate effort to enhance flame, ultra-violet and abrasion resistance on spun-bonded/melt-blown shelter materials. Establish in-house capability to assess noise attenuation properties of textile materials and composites. Relationship between material properties and mechanism of acoustical energy attenuation will be determined. Initiate development of single item of combat clothing with multiple protective capability. Continue work on heaters, tent fabrics, inflatable beams, and habitability problems. Complete work on plastic tent frames. Continue dynamic

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analysis of frame-and-panel designs for tactical rigid-wall shelters. A more general dynamic ana. sis using a less detailed model will also be initiated, and blast overpressure loading will be included. Continue the evaluation of non-destructive testing (NDT) devices and make a determination as to the suitability for Army use. Continue the study of the effect of thermal loading on the delamination of honeycomb panels. Initiate development of design methodology for tactical shelters exposed to the NBC/ballistic threat.

3. (U) FY 1981 Planned Program: Initiate development of flame resistant and chemical protective undercoverall for combat vehicle and aircraft crews. Develop elastomeric materials for use in CB protective systems. Develop combined reactive/sorptive materials. Investigate new methods of incorporating active charcoal in flexible cellular materials. Award contracts for wet- and dry-laid nonwoven materials with activated carbon for CB applications. Develop laundry supplies and wash formulations for delousing/decontaminating CB clothing to enhance service life. Initiate study of predominate failure modes of Kevlar upon high-speed impact with conventional/high density fragments. Continue work on new concepts to incorporate CB, ballistic and flame protection into single item of combat clothing; and reduce weight and bulk of standard clothing while maintaining protective quality. Fabricate uniforms with low-infrared emittance and evaluate reduction of solder's thermal signature. Quantify interaction of night vision sights with eye to give better understanding of effects of camouflage patterns at night. Initiate critical assessment and evaluation of all standard clothing tariffs (sizes) for Army men/women. Utilize integrated sizing study data to draft initial single-size clothing system patterns. Evaluate new materials and systems being proposed for military use for susceptibility to microbiological degradation. Complete efforts on tent fabrics and heater. Continue work on habitability, CB protection, and design for tents. Start work on improving field latrine/bath/laundry/waste disposal systems. Complete dynamic analysis of the frame and panel shelter, and initiate an optimum design study for tactical rigid-wall shelters. Continue the study of delamination of honeycomb panels with investigation of both nondestructive testing (NDT) methods and mechanisms which cause the delamination. Continue to develop designs for tactical shelters to meet the NBC/ballistic threat, and to define potential design modifications and trade-off costs to meet the specified threat. Personnel involved: professional 51, support 40.

4. (U) FY 1982 Planned Program: Continue research on fibers/fabric for chemical/biological (CB) protective ensembles with specific emphasis on applying rationalization, standardization, integration (RSI) principles to development of CB clothing. Continue investigating candidate CB agent-impermable materials; developing elastomeric coating systems and films; investigating new methods to incorporate active charcoal in flex cellular materials to improve the form of binder and activated carbon; developing activated carbon-filled hollow fiber; preparing activated carbon fabric and yarn from petroleum pitch; developing laminated fabric structures, studying perspiration poisoning response of materials; and analyzing the structure and physical property relationship for elastomers. Develop laundry supplies/wash formulas for delousing/decontaminating CB

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Title: Clothing, Equipment, and Shelter Technology
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clothing. Continue development of new concepts to employ advanced insulation materials into cold weather clothing. Analyze areas of conflict in interoperability of camouflage materials among North Atlantic Treaty Organization (NATO) countries and initiate means for overcoming them. Evaluate materials newly released to commercial market for flame retardance properties and possible military application. Devise protective concepts for self-supporting and frame supported structures and consider homogeneous and heterogeneous fabric panels and laminates. For tactical rigid wall-shelters, expand the optimum design with new structural concepts in addition to the frame-and-panel concept. Continue panel design and NDT studies including requirements for blast and ballistic protection. Continue to investigate and support the establishment of NBC/ballistic requirements and to define design modifications and trade-offs required in tactical shelter structures to meet specific threat levels. Investigate means for rapidly moving tactical shelters short distances (approximately 1000 feet) for complexing (joining) shelters.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #AH98 Title: Clothing and Equipment Technology
Program Element: #6.27.23.A Title: Clothing, Equipment, and Shelter Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This program is designed to improve 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 detection by 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 efforts to improve field service equipment, field life support facilities, and the development of design criteria for field shelters.

B. (U) 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 Program Element (PE) 6.37.47.A, Soldier Support/Survivability, and to Engineering Development under PE 6.47.13.A, Combat Feeding, Clothing and Equipment.

C. (U) WORK PERFORMED BY: The major in-house effort is performed by the US Army Natick Research and Development Command, Natick, MA. Other Government activities involved are US Army Aeromedical Research Laboratory, Ft Rucker, AL; US Army Materials and Mechanic Research Laboratory, Watertown, MA; and US Army Chemical Systems Laboratory, Aberdeen Proving Ground, MD. Known contractors are Libby Co, Lewiston, ME; Rohm & Haas Co, Springhouse, PA; Kimberly Clark, Lee, MA; FRL Corp, Dedham, MA; Union Carbide Co, Cleveland, OH; NC State University, Raleigh, NC, for contracts worth $430,000. There are seventeen (17) other contracts worth $1,137,000

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: A psychophysical study of the factors that relate to the design of camouflage patterns was completed and published. A series of reports on the anthropometry of the women of the US Army was completed and published. Fitting and sizing study for women of field trousers and liner, leather gloves and insert, helmet liner cap, and chemical/biological (CB) ensemble was conducted. Study of mental and psychomotor performance of men under high temperature and humidity was conducted, and a similar study was initiated for women. Processes and methods to obtain carbon-laminated or impregnated materials with optimum CB protection were evaluated. Also, the possibility of combining CB protection with flame resistance was investigated, and several flame-retardant finishes were tested on the standard overgarment material. Filters

Project: #AH98 Title: Clothing and Equipment Technology
Program Element: #6.27.23.A Title: Clothing, Equipment, and Shelter Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

with a range of spectral and transmission characteristics designed to provide optimum eye protection when used with specific photochromic dye systems were obtained. An experimental test method was developed to impact individual textile yarns ballistically and to measure the material reaction in quantitative units of stress, strain, and time. Computerized colorant programs (pigment & dye) were validated and are now used routinely. Development of a statistical method to evaluate results of color-matching of shades was completed. New task initiated to study the response of materials to noise and over-pressure. Several nonwoven and novel materials are being investigated for the following potential applications; canopies of cargo parachutes, personnel shelters, and flame-resistant clothing.

2. (U) FY 1980 Program: In area of fibers/fabrics for chemical/biological (CB) protective ensembles, exploit the potential of wet-laid nonwoven materials containing activated carbon. Initiate a study of dry-laid nonwoven materials with activated ingredient for CB application. Evaluate chemical protective materials to determine sorptivity, surface area, and textile/physiological properties. Investigate improved charcoal binders, formulations and materials for CB application. Investigate feasibility of preparing activated carbon from pitch using a continuous process. Continue compounding of butyl phosphazene rubber fabricated into molded or dipped sheets and coated fabrics. Conduct feasibility study on use of wrapped carbon yarns, crushed foam, and spun bonded/melt blown webs for chemical protective properties. Study effects of atmospheric conditions on carbon-impregnated materials. Other areas of research include using new concepts to employ advanced insulating materials in cold-weather clothing. Complete design and fabrication of radar-absorbant material. Investigate woven and nonwoven fabrics for camouflage in snow-covered terrain and develop improved camouflage of shelters in conventional tactical employments. Prepare collation of all available anthropometric data on women, both military and civilians. Anthropometric data will be analyzed to provide basis for development of integrated sizing system for field clothing patterns. Fitting/sizing study will be conducted on flight coveralls worn by female personnel. Evaluation of men's cold-wet and cold-dry clothing components on females will continue. Biomechanical load-carrying analysis on males/females using modified load-carrying equipment will be conducted. Establish in-house capability for moisture permeability evaluation. Initiate effort to enhance flame, CB, and abrasion resistance on spun bonded/melt blown shelter materials. Continue drop test of scrim-reinforced nonwoven parachutes. Establish in-house capability to assess noise attenuation properties of textile materials and composites. Relationship between material properties and mechanism of acoustical energy attenuation will be determined. Achievable physical property levels as functions of controllable textile/composite parameters will be identified for both steady-state and impulse noise threats. Continue work on heaters, tent fabrics, inflatable beams, and habitability problems. Complete work on plastic tent frames.

3. (U) FY 1981 Planned Program: A greatly expanded research program on fibers/fabrics for chemical/biological (CB)

Project: #AH98 Title: Clothing and Equipment Technology
Program Element: #6.27.23.A Title: Clothing, Equipment, and Shelter Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

protective clothing will be undertaken to develop a material which is lighter weight and air-permeable while preventing passage of toxic agents. Initiate development of flame-resistant and chemical protective undercoverall for combat vehicles and aircraft crews. Develop elastomeric materials for use in CB protective systems, to include elastomeric coating systems or films. Investigate enzyme-treated fabrics. Develop combined reactive/sorptive materials for CB application. Investigate new methods of incorporating active charcoal in flexible cellular materials. Award contracts for wet- and dry-laid nonwoven materials with activated carbon for CB applications. Determine stability of chemical protective clothing system to high and rapid temperature changes. Develop laundry supplies and wash formulations for delousing/decontaminating CB clothing to enhance service life. In other areas, initiate study of predominate failure modes of Kevler upon high-speed impact with conventional/high-density fragments. Continue work on new concepts to incorporate CB, ballistic, and flame protection into single item of combat clothing, and reduce weight and bulk of standard clothing while maintaining protective quality. Fabricate uniforms with low infrared emittance and evaluate reduction of soldier's thermal signature. Fabricate/evaluate snow camouflage materials. Quantify interaction of night vision sights with eye to give better understanding of effects of camouflage patterns at night. Initiate critical assessment and evaluation of all standard clothing tariffs (sizes) for Army men/women. Utilize integrated sizing study data to draft initial single-size clothing system patterns. Evaluate new materials and systems being proposed for military use for susceptibility to micro biological deterioration. Complete work on new tent fabrics and tent heater. Continue work on habitability, CB protection, and design for tents. Initiate work on improving field latrine/bath/laundry/waste disposal systems. Personnel involved: professional 44, support 36.

4. (U) FY 1982 Planned Program: Continue research on fibers/fabrics for chemical/biological (CB) protective ensembles with specific emphasis on applying rationalization, standardization, integration (RSI) principles to development of CB clothing. Investigate candidate CB agent-impermeable materials; develop elastomeric coating systems and films; investigate new methods to incorporate active carbon charcoal in flex cellular materials to improve the form of binder and activated carbon; develop activated carbon-filled hollow fiber; prepare activated carbon fabric and yarn from petroleum pitch; develop laminated fabric structure; study perspiration poisoning response of materials; and analyze structure and property relationship in elastomers. Develop laundry supplies/wash formulas for delousing/decontaminating CB clothing. Continue development of new concepts to employ advance insulation materials into cold weather clothing. Continue design studies for camouflage of shelters. Analyze areas or conflict in interoperability of camouflage materials among North Atlantic Treaty Organization (NATO) countries and initiate means for overcoming them. Evaluate materials newly released to commercial market for flame-retardance properties and possible military application. Screen new material development for noise attenuation capability. Devise protective concepts for self-supporting and frame supported structures, and consider homogeneous and heterogeneous fabric panels and laminates.

Project: #AH98 Title: Clothing and Equipment Technology
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5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	3432	3292	5895	4233	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	3085	3295	5981	Not Shown	Continuing	Not Applicable

Additional funds in FY 1979 reflect increased efforts on defeating microbial deterioration and contamination of materials.
Decrease in funding in FY 1981 represents refinement of estimates in project AH98.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.24.A
Title: Joint Services Food System Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7852	5552	6088	7850	Continuing	Not Applicable
AH99	Joint Services Food System Technology	7852	5552	6088	7850	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides military food science Exploratory Development projects conducted by the Army as Executive Agent of the Department of Defense (DOD) Food Research, Development, Testing and Engineering (RDT & ENG) program for all the Services and the Defense Logistics Agency (DLA). It is designed to meet military-unique food system problems encountered in garrison, ground combat, air and shipboard operations on a total systems basis. The United States (US) food industry and other government agencies do not focus on the special food problems encountered by the Services in the actual and potential overseas military mission (deployment) areas. Examples of these problems are extended shelf life to accommodate the requirements for prepositioned food reserves, reduced weight and volume to minimize requirements for storage space on ships, reduced transportation and shipping requirements, and minimization of warehouse requirements in overseas areas; protective packaging to prevent losses from pests and the effects of less-than-optimim storage conditions, simplified preparation requirements to minimize food-service skill requirements in the combat zone; and management of the food logistics requirements so as to minimize the impact of these requirements on the logistic support needs of the total force. The logistical resources required to support a highly acceptable combat food service system represent a significant portion of the total force, requiring a complex transportation, storage, and distribution 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 Joint Service program is to streamline the overall requirements of the DOD food system consistent with available and projected food technology capabilities from the US and foreign food industry, supplemented with in-house developments where unique military food system requirements cannot be met.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: This program provides for analysis and design of Military Feeding Systems, by integrating the separate technologies of food, food-service equipment design, and food sanitation into a systematic approach to the

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development of Navy (USN) shipboard feeding systems, Marine Corps (USMC) garrison feeding system, and Air Force (USAF) mobilization feeding system to include a mobile food-service system for the USAF Ground-Launched Cruise Missile System, and a joint Army-Marine field feeding system. A new technology area is included for the first time in this program for in-house scientific expertise to address military-unique problems in nutrition and food wholesomeness which are encountered not only under the hostile, hazardous conditions of the battlefield but also as a result of increased reliance on highly mobile and complex weapon systems and the need to properly subsist and sustain the personnel who operate these systems. The systems approach used in this research will: determine the capability and efficiency of existing food service systems, examine new food-service requirements under evolving weapon systems, and changing combat strategies, identify potential contributions of available and projected new foods and equipment and define needs for development of improved food system capabilities. The objective in each case is to develop for the Joint Services, improved food-service systems which meet military needs with minimum logistical "cost". This will be accomplished by exploiting technological advancements from industry wherever possible and supplemented with in-house developments where necessary.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	7852	5552	6088	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	6000	7453	9334	Continuing	Not Applicable

(U) Significant differences between the FY 1980 submission and current requirements are related to reductions in the scope and objective of the irradiated food research program. The Army has decided to terminate its research program on irradiated food in FY 1980. No funds are being requested for irradiated food research in FY 1981. An offer to transfer irradiated food research assets has been made to the US Department of Agriculture. If accepted, this transfer will be accomplished in FY 1980. The increases between FY79 (current requirements) and FY79 submission are due to internal restructuring of programs including Nutrition and Food Hygiene Research formerly carried under PE 6.27.72.A.811. The decrease between FY80 submission and FY80 (current requirements) is due to a Congressional reduction.

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E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.24.A
Title: Joint Services Food System Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Insuring a safe, wholesome, and nutritious food supply under conditions of combat, emergency mobilization, and peacetime training is a basic responsibility of all the Services. While the current US commercial food system provides a high-quality food supply, it is based on a highly developed and sophisticated distribution system with great reliance on perishable food components. In many of the actual and potential overseas military mission (deployment) areas, the continental United States (CONUS) commercial food system cannot be projected, along with the combat forces, without extensive reliance on refrigerated shipping and the construction of refrigerated warehouses and handling facilities. The commercial food industry is oriented on the relatively easy trip from farm to supermarket, whereas the military must have operational rations suitable to be shipped almost anywhere, be stored under adverse conditions for long periods of time, and still be affordable, safe, and taste reasonably good to soldiers, sailors, and airmen. 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 (USA), Navy, (USN), Marine Corps (USMC), Air Force (USAF), the Defense Logistics Agency (DLA); and is part of the Department of Defense (DOD) Food Research, Development, Testing and Engineering (RDT&ENG) Program managed by the Army for the DOD. It address military-unique food problems that are not addressed elsewhere in the government nor by the commercial food-service industry.

C. (F) RELATED ACTIVITIES: Work conducted in this program is part of the DOD Food RDT&ENG program which also includes programs in the following: 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; and 6.47.13.A, Project D548, Military Subsistence Systems. This is a coordinated Joint Services Program. There are no other Services requests for food research; therefore, no duplication of effort.

H. (U) WORK PERFORMED BY: The majority of effort is conducted in-house by the US Army Natick Research and Development Command, Natick, MA. Other Army and government laboratories providing assistence 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 and the General Services Administration. Various academic institutions perform work in this program such as University of Nebraska, Lincoln, NE; Bowling Green University, Bowling Green, OH; Massachusetts Institute of Technology and Harvard University, Cambridge, MA; Baylor College of Medicine, Houston TX; Worcester Polytechic University, Worcester, MA; New York University, NY, NY; Texas A&M University, College Station, TX; and University of California, Los Angeles, CA. Other institutions which have been involved in contract work are National Academy of Science, ARA Food Services, Philadelphia, PA; General Electric Co., Schenectady, NY; Ralston Purina Corp., St. Louis, MO; Simcon, Inc., McLean, VA; and Factory Mutual Research Corporation, Norwood, MA.

Program Element: #6.27.24.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Joint Services Food System Technology
Budget Activity: #1 - Technology Base

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Weight and volume reduction in food components have been achieved through Army-developed freeze dehydration and compression techniques. These foods are highly acceptable and provide a means for reducing frequency of food replenishment on Navy ships. Rations based on these developments have extended the capability of long-range ground combat patrols, and are being applied in the development of a USMC Assault Packet to sustain Marines in early assault phase. The Assault Packet reduces logistical support requirements below that of the current standard individual combat ration. Another Army development, the flexible retort pouch, is providing a basis for reducing our dependence on the tin and steel in "tin" cans of current combat rations and also gives a 20-percent reduction in weight of the combat ration. A food-service system developed for the Navy has been installed on fleet carriers. A new Marine base food-service system developed by the Army significantly increased individual Marine satisfaction and raised participation rates by those military personnel authorized to subsist at government expense. A variety of highly acceptable liquid diet preparations for dental and other hospital patients was developed to replace bland, tasteless preparations currently in use in military hospitals. A concept study of future field feeding for the Army of the 90's was completed and potential economies (to be gained by exploiting technological advances in food) in manpower and other logistical resources were identified. Personnel involved: professional 97 and support 52.

2. (U) FY 1980 Program: Continue storage, stability, processing technique, and human acceptance studies of new and modified subsistence items and rations; continue analysis and design and development of USAF Food Service Mobilization System; complete analysis and design and prototype development of Army Hospital Food Service System Operations; continue studies on insect resistant food packaging; continue analysis and design and prototype development of Navy Food System Afloat; develop improved food-packaging methods consistent with current handling and storage techniques; continue development of new multi-serving packages and combat food item prototype development; continue cooking/baking equipment studies; initiate development of improved food-service system for remote or isolated locations; and initiate combustion technology program for improvement of field stoves and cooking equipment to include use of future alternate fuels.

3. (U) FY 1981 Planned Program: Continue storage, stability, processing techniques, nutritional adequacy, wholesomeness, and human acceptance studies of new and modified substance items and rations; complete USMC garrison feeding studies and prototype development; complete USAF Mobilization System Study, to include Ground-Launched Cruise Missile System, complete design work on Field Food-Service Service Systems for the Army and USMC; continue shipboard feeding systems design/development; continue development of methods for improved packaging/storage/shelf-life to reduce food losses for Defense Logistics Agency; continue remote/isolated site food system development; and initiate field food service sanitation technology program to reduce

Program Element: #6.27.24.A
Title: Joint Services Food System Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

hazards of microbial contamination of military subsistence materiel. A new technical effort will be included to provide for application of nutrition and food hygiene technology to support the development of new military food systems.

4. (U) FY 1982 Planned Program: Continue storage stability processing techniques, nutritional adequacy, wholesomeness and human acceptance studies of new and modified subsistence items; continue shipboard feeding systems designs for different ship classes, development of foods and equipment for Army and USMC field feeding, design and development of USAF Ground-Launched Cruise Missile System, develop and test nutrition education and weight control course for the use of the Services, continue development of methods to reduce food losses for Defense Logistics Agency, and complete remote/isolated-site food system development.

5. (U) Program to Completion: This is a continuing progam.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.25.A
Title: Computer and Information Sciences
DOD Mission Area: #521 - Electronic and Physical Sciences
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2510	1269	2009	2119	Continuing	Not Applicable
DY10	R&D in Multicommand Data Systems	2085	1269	2009	2119	Continuing	Not Applicable
A778	Human Factors in Programming	175	0	0	0	N/A	175
AT11	Engineering Software	250	0	0	0	N/A	250

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element includes RDT&E funds for the research and exploratory development of general computer software techniques for use by all Army agencies in the development of operational software. The techniques will aim to reduce costs of computer software, make computer software costs visible, and reduce duplication of effort. Four technology areas in the Defense Computer Resources Technology (DCRT) Plan are supported by this program element. Some major thrusts within the four technological areas are: Development of Life Cycle Management Tools - to help the Department of the Army, defense agencies, and industrial program managers better plan and control software development process; Development of Advanced System Design and Architecture Concepts - to improve the reliability, usability, adaptability, and cost-effectiveness of defense computer applications; Specification and Development of Standard Software Products - To focus on the Software Standardization and Implementation Maintenance Tools for military programming languages and computers, and for military systems used by the three services and to facilitate NATO interoperability; and Development of Advanced Computer Hardware Technology - to meet unique Department of the Army and defense agencies' needs. Advanced ADP technology is urgently needed to meet post-Tactical Management Information Systems (TACMIS) and Vertical Installation Automated Baseline (VIABLE) Battlefield Automation requirements and support large-scale mobilization needs for logistics, training, status information provided to all command levels for informed decisionmaking. Research objectives primary support modernization of ADP hardware systems and upgrading of large software systems presently used in Army installations throughout the world. Advanced development practices are also needed to substantially reduce development time, reduce software maintenance costs, and provide a concept for increasing the quality of the Standard Army Multicommand Management Information Systems (STAMMIS). The four areas of research address needed modernization of Army automation as documented in the Federal Data Processing Reorganization Project (FDPRP) Study.

Program Element: #6.27.25.A
DOD Mission Area: #521 - Electronic and Physical Sciences

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

C. (U) BASIS FOR FY 1981 RDTE REQUEST: The FDPRP Study documented a pressing need for modernization of current Army ADP Systems. Major criticisms of current Army Systems have identified the following problems: they are difficult to maintain or transport; they cannot react quickly to change; e.g., increased workload or new requirements, and they are extremely vulnerable to the various environmental hazards encountered in field operations. Current procurement actions in TACMIS and VIABLE will provide hardware upgrades, but existing software is obsolete. It is essentially incapable of effectively utilizing the hardware resources that will be made available. More importantly it is incapable of reacting effectively to projected Army needs in a wartime environment. The Army's tremendous investment in obsolete systems makes it impossible to "overlay" new technology on existing systems. These needs can only be met through a redesign of current systems which permits the introduction or the latest technology. In response to these conditions, the US Army Institute for Research in Management Information and Computer Sciences (AIRMICS) R&D Program objectives for FY81 are aimed at providing the following capabilities. Requirements Analysis area will provide an automated baseline over the life of the product. Metrics and Planning technology area will put several prototype automated decision support systems in use by both the Logistic Center and the US Army (USACSC). The Automated Project Management System (APMS) gives the software manager an effective tool to manage the development phases, estimate resources, plan milestones for good utilization of resources, and defend the plan against unwarranted changes by immediately determining impacts on cost, schedule, and quality. Distributed System Research area will develop requirements and a draft Required Operational Capability (ROC) for future information systems. The advanced technology of distributed networks of data bases, micro computer system components, compact mass storage devices, fiber optic teleprocessing, advanced software architectures and concepts will provide cost-effective solutions to future Army information system needs. Also, very substantial reductions in development, maintenance, and operations personnel can be achieved with this advanced technology.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	2510	1969*	2009	-	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	2510	2496	2478	-	Continuing	Not Applicable

*Decrease in FY80 was due to a Congressional reduction in project DY10 and deletion if funding for projects A778 and At11. In FY81 funds have been reduced to accommodate impact of FY80 reductions.

Program Element: 6.27.25.A
Title: Computer and Information Sciences
DOD Mission Area: 521 - Electronic and Physical Sciences
Budget Activity: 1 - Technology Base

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

AD-A082 155 DEPUTY CHIEF OF STAFF FOR RESEARCH DEVELOPMENT AND AC--ETC F/G 15/5
DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS OF THE RESEARCH, DEV--ETC(U)
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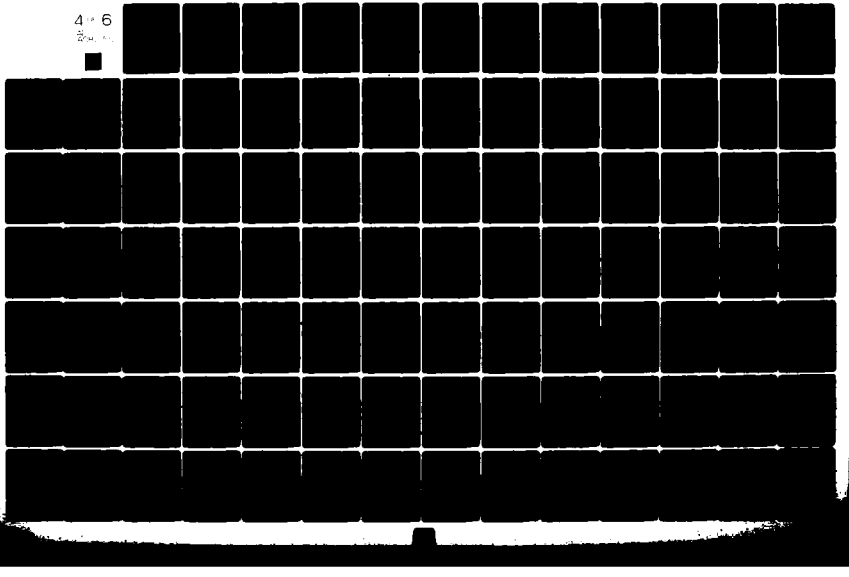

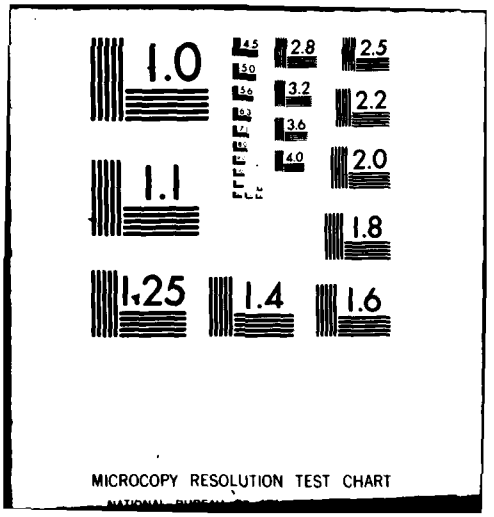
1.0
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5.6
MICROCOPY RESOLUTION TEST CHART

Program Element: #6.27.25.A
DOD Mission Area: #521 - Electronic and Physical Sciences

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

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Today's Army software systems are large and complex. Future Army systems are likely to be even larger and more complex. The rising cost of software, particularly during the maintenance phase, coupled with falling user satisfaction point to a lack of quality in the software being produced today. Little is known about the factors that influence quality and complexity, making a quantitative assessment difficult. The objectives of this research are to identify those factors that influence quality and complexity, establish quantitative measurements, and identify how those factors can be influenced to reduce maintenance costs and improve costs and improve user satisfaction. The AIRMICS research efforts are aimed at developing an integrated system of tools and procedures. This system will aid the user in formulating, stating, and communicating his requirements. It will also facilitate the analysis of those requirements and provide feedback to the user regarding the implications of his requirements so that he can validate their correctness. The results expected from this research are a set of well-defined functions that, when used in close interaction between users and developers, will yield high quality requirements and will result in lower maintenance costs, as well as improved responsiveness to user needs. Requirement Analysis R&D effort will complete the adaption and the evaluation of existing automated requirement tools (i.e., Computer-Aided Design and Specification Analysis Tool (CADSAT), Software Requirements Engineering Methodology (SREM), etc.) to the Army agencies responsible for defining, developing, and maintaining complex information systems. A version of incorporating several features of each is expected to be transferred and put into use by the Logistics Center and USACSC at Fort Lee, VA. This program element also includes research into defining, developing, and maintaining responsive computer-based systems utilizing advanced technology which will substantially increase wartime preparedness, as well as reduce operational costs. Automated Requirements Systems (ARS) will incorporate a concept of system sketch and man-machine emulation for evaluating interface specifications. Metrics and Planning Technology - Research efforts here will develop a software manager's terminal using a micro computer, smart graphics terminal with a set of interactive tools. Tools available will be software resource estimating, PERT, Critical Path Methods, and GANT tools. Substantial efforts will be applied to adapting the Project Management Guidebooks and the latest ADP acquisition methodologies and tools to upgrade management practices in the Computer Systems Command, interacting MACOMS and proponent agencies. Distributed Systems research is focused on computer hardware and software concepts for future information systems. Anticipated State-of-the-Art developments in the computer industry and the Military Computer Family will be investigated as alternative architectures. Support of Present Standard Languages will primarily address the life-cycle phases of software development and maintenance in the standard high order language of COBOL and the future Ada language. Principle focus will be on upgrading the testing methodology. This will yield an improved software product and substantial cost reduction in the development and maintenance phase. Most important, it will reduce malfunctions due to software errors in the hundreds of locations throughout the world where multicommand systems are run. Secondary emphasis will be one evaluating advanced automated programming systems that will reach maturity in FY81.

Program Element: #6.27.25.A
DOD Mission Area: #521 - Electronic and Physical Sciences

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

G. (U) RELATED ACTIVITIES: The Army's Military Computer Family program (MCF PE and Project No. 6.37.23.A/D101) Hardware, Software and Instruction Set Architecture Product Planning is developing a compatible computer family and a high order language, Ada, which has application in advanced information systems. The Army's Integrated Software Research and Development (ISRAD) program received support from Project 6.58.03.A/MY 29 (Integrated Software). Participating development agencies include the Office of the Chief of Engineers, US Army Research Institute, and the US Army Computer Systems Command. Research projects supported by this PE are coordinated by the DOD Management Steering Committee for Embedded Computer Resources, and other DOD panels/committees. Continued liaison at the laboratory and action officer level with the Navy and Air Force counterparts minimizes duplication of work. Several cooperative research projects are funded by the Rome Air Development Command (RADC) and the Naval Reserve Laboratory (NRL).

H. (U) WORK PERFORMED BY: General Research Company, Huntsville, Al; Georgia Institute of Technology, Atlanta, GA; RAVEN Systems and Research, Inc., Washington, DC; Kansas State University, Manhattan, KS; Purdue University, Lafayette, IN. In-house developing agencies include: US Army Institute for Research in Management Information and Computer Sciences (AIRMICS), Atlanta, GA; and US Army Research Institute, Alexandria, VA; US Army Waterways Experiment Station (WES), Vicksburg, MS; US Army Construction Engineering Research Laboratory, Champaigne, IL. Graphics Interface is performed by the in-house Corps of Engineers (COE) staff members at WES, Vicksburg, MS.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: US Army Research Institute for Research in Management Information and Computer Sciences (AIRMICS)-USACSC's Multicommand Data Systems Project (DY10): Technological Accomplishments during FY 1977 included the following key efforts: Successfully consolidated into a single requirements document the various features for higher order programming languages for all mission areas (strategic and tactical), for real-time and non-real time processes, for parallel processing architecture, and for input/output intensive process control applications. Published a 15-volume set of guidebooks for the software community describing "how to do" structured programming; issued two handbooks describing for government managers "how to" formulate and manage software development in defense programs. Demonstrated a specialized lightweight, miniature, low-power handheld data entry/display terminal suitable for a military field environment. Major Accomplishments during FY 1978 include the development of a cost estimation and sizing model. Although it was originally aimed at decision support applications (command and control and management information systems), initial experiments indicate it has wider applications. An Information Processing of Systems Simulator (IPSS) was used as a sketching tool for the Standard Installation Division/Personnel System (SIDPERS) in back-end, interactive configuration. Jointly, with the Federal Computer Performance Evaluation and Simulation Center (FEDSIM), and Navy, conducted an evaluation of the suitability

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of IPSS for use by DOD in computer performance prediction, sizing, and design optimization. Major Technological Accomplishments during FY 1979 include the development of a complementary requirements technology called "System Sketching" to provide early feedback about system characteristics to prospective users. Established the feasibility of emulating man-machine interface specification with direct user participation to actual formats, machine processes and error messages. Selected three existing tools (i.e., CADSAT, SREM, and Input Output Requirement Language (IORL)) and planned extensions for information system applications. Evaluated a group of software management tools for integration into the smart terminal system over a two-year period; two terminals will be placed in operational development environment for early-user feedback. Demonstrated the concept of a Back-End Data Base Management System (DBMS) on a minicomputer for possible application to future information systems architecture. Developed and demonstrated a hardware network of three microcomputers interconnected to a minicomputer. To preserve large previous investments, investigation efforts were made into portability of COBOL languages to multiple vendor hardware which concluded with an identification of a proper COBOL subset and mapping algorithm and in the testing area, the feasibility of testing for FORTRAN and COBOL programs, based on internal replacement of operators/operands was established. US Army Corps of Engineers (COE), Engineering Software Project (ATII): Major accomplishments during FY 1977-79 include the following key efforts: Developed a standard software system for COE's Graphics Compatibility System (GCS) - the Waterways Experiment Station (WES) ADP Center developed several applications using GCS was enhanced and modified to support state-of-the-art graphics techniques. Both a two-dimensional and a three-dimensional version of GCS are available and can be used with several graphics devices on different computers. New capabilities include data structures, segmentation, psuedo display files, and Hershey software character fonts. User base for GCS has been increased to over 50 local, state, and Federal Government (including DOD) installations.

2. (U) FY 1980 Program: Specific AIRMICS-USACSC research efforts include the evaluation of existing tools (CADSAT, SREM, and IORL) which will be completed, and design interface mapping to design will be initiated. USACSC and interacting proponent agencies will participate in several software development pilot programs using CADSAT and contribute to developing the Automated Requirements Systems (ARS). System sketch alternative approaches of functional simulation and reusable modules will be implemented with in-house staff for evaluation. Emulation of man-machine interface specifications will be extended to an operational module of ARS. Specific efforts in Metrics and Planning Technology will include two Automated Project Management System (APMS) that will be integrated into operational development environments. Software resource estimation methods will be adapted for USACSC and their effectiveness evaluated. Interface will be defined for integration of APMS with existing project performance and controls systems with in-house staff. Distributed Systems: specific efforts here focus on the exploratory concepts for future information systems task which will complete the Army user requirements. The Back-End DBMS, the microprocessor network configuration and the operating systems concepts will be evaluated and optimized. Support of Present Standard Languages: Efforts here focus on the support of current standard programming language

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including the development of programming tools. Development of the prototype test evaluation system will continue for application to USACSC testing methodology. The software science quality investigations will continue with the joint Rome Air Development Center extension of the postulated quality measures to COBOL programming environment and the USACSC's Quality Assurance operational environment. Experiments supported with in-house staff will inveatigate the use of software science results to cost and schedule estimation.

3. (U) FY 1981 Planned Program: Continue development of ARS and Initiate transfer to Proponent Agencies and operational elements of the USACSC. System sketch module will be completed and will include emulation of man-machine interface specification and functional simulator. Metric and Planning Technology: Additional APMS terminals will be procured and installed in each operational Computer Systems Command development area. Software resource estimation methods and programs will be integrated into APMS. Army-wide decision support system application will be evaluated for selected technology transfer. Management and operations procedures with TACMIS hardware integration into worldwide operation will be studied and recommendations for changes made to responsible agencies. Distributed Systems. Requirement formulation for competitive procurement of alternative designs for advanced information systems will be initiated and completed. Procurement action for industry teams to propose alternative hardware and software designs will be initiated and proposal evaluations completed. In-house demonstration of a Standard Army MIS implemented on the network sysem of microprocessors and smart terminals will continue. Multilevel security concepts will be evaluated for integration into the network operation system. Support of Present Standard Languages. The test evaluation tool will be completed and evaluation efforts undertaken within USACSC. Investigations of automated programming tools available in industry will be completed with a number of exploratory pilot projects within CSC completed. The major new thrust initiated the previous year with in-house staff will address substantial cost reduction of software maintenance. Software science benefits of understanding internal program structure related to maintenance is expected to yield results. Also, USACSC use of quality measures in Quality Assurance and Quality Control is expected to yield substantial software development improvements. Number of personnel involved in this effort are: professional, 19; support, 6.

4. (U) FY 1982 Planned Program: Requirements Analysis: Evaluations of the Automated Requirements System will be completed. Additional research in system sketch will develop out of operational use of existing tools and application of system sketch in operational areas of USACSC and interacting agencies. Metrics and Planning Technology: Develop management decision support systems which address the need for informed decisionmaking at each level of command. Start development of Standard Operation Procedures Handbooks for Data Processing Installations. Complete evaluation of Automated Decision Support System interfaced with standard project control systems. Distributed Systems. Alternative concepts for advanced information systems will be completed with selection of the most promising candidate for Test Bed Development. Detailed

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development and evaluation procedures defined for Test Bed Procurement will be initiated. In-house evaluation of distributed network will be continued and integration of multilevel security concept will be continued. Support of Present Standard Languages: Research planning will be dependent on operational experiences with quality measures within the USACSC. Software maintenance methods and tools will be continued with emphasis on high cost factors.

5. (U) Program to Completion: This is a continuing Program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.27.A Title: Non-Systems Training Devices (NSTD) Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2456	2955	3457	4014	Continuing	Not Applicable
A230	NSTD Technology	2456	2955	3457	4014	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program provides for the Exploratory Development of Non-Systems Training Devices (NSTD). Non-Systems Training Devices are developed to support general military training, and training on more than one item/system, as compared with system-related devices that are developed in support of a specific item/system. The combat effectiveness of Army personnel is critical to both compensating for the numerical superiorty of opposing forces and for maintaining a militarily ready force. This combat effectiveness can only be achieved by innovative, efficient, and results oriented training. Modern technology, manifested by modern training devices, can provide the means to accomplish this required training. The major thrust in the development of new training devices is to develop devices allowing a high transfer of knowledge and experience from the training situation to a combat situation. The Army must train as it is to fight. Studies have indicated that units training with REALTRAIN Engagement Simulation System, a first generation engagement simulation system, have become significantly more combat effective than units training with previously standard methods. These results reflect progress in meeting the basic challenge of providing learning situations which have the requisite fidelity to require the same decisions and techniques in training as those required in combat. Training devices also offer another potential for improving the combat effectiveness of the Army. Studies have indicated that the proficiency of both individuals and units decrease significantly during periods between field or weapons live-firing exercises. Constrained training resources preclude a more frequent occurrence of these live-firing activities. Training devices afford the potential to simulate aspects of these "refresher" activities within garrison locations. Improved training devices, now available through modern technology, must continue to be developed to allow the training required to prepare United States soldiers to fight outnumbered and win.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Funds requested provide for development of concepts for incorporating United States (US) weapon systems, enemy weapon systems, and exercise control instrumentation into engagement simulation exercises. Research and analyze concepts for the application of computer technology and automated data handling to exercise control systems. Continue the development of selected wide angle visual display systems. Continue the development and evaluation of Computer

Program Element: #6.27.27.A Title: Non-Systems Training Devices (NSTD) Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

Generated Imagery (CGI) techniques. Continue the Exploratory Development of training devices to increase the effectiveness of maintenance training. Inititate programs to explore the more effective use of real time feedback in maintenance trainers. Explore approaches for introducing opposing force targets into established firing ranges. Continue research on the means to simulate the weapons signature of small arms. Initiate development and evaluation of High Detail Daylight Display for Nap-of-the-Earth flight training.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	2456	2955	3457	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	2750	2955	3726	Continuing	Not Applicable

The reduced funding in FY 1979 indicated in the current submission reflects the reprograming of funds to higher priority Department of the Army (DA) projects. The reduced funding in FY 1981 is due to the transfer of funds to higher priority DA projects.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.27.A Title: Non-Systems Training Devices (NSTD) Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This continuing Program provides for the Exploratory Development of training devices which are developed to support general military training and training on more than one item/system. The effort under this Program is directed towards providing a technology base in support of Army training device development. The cost of training with operational equipment, the lack of available training areas, and the need for high levels of proficiency to achieve full combat effectiveness requires continuing examination of approaches to simulation and training devices. This Program provides the necessary "front-end" analytical effort required for developments to smoothly transition into Advanced Development and Engineering Development. The Program is structured into five technology areas. (1) Engagement Simulation: To develop technologies to support training associated with the conduct of large scale, two sided combined arms field exercises in typical modern battlefield environments. (2) Maintenance Simulation: To develop technologies for reducing dependency on the use of operational equipment for maintenance training. (3) Visual Simulation: To develop technologies associated with visual presentation of information, non-programmed real world scenes and simulated imagery. (4) Electro- Mechanical Simulation: To develop technological approaches for producing replicas of operational equipment, weapons effects simulation techniques, targets, sub-caliber firing devices and other items related to general recurring training device needs. (5) Electronic Simulation: To develop technologies for applications of electronic techniques associated with computer, communications, automatic control, and sensors to support and pioneer training approaches.

G. (U) RELATED ACTIVITIES: To avoid duplication of effort, close coordination is maintained with other Services through Training and Personnel Technology Conferences, Topical Reviews, Joint Service Technical Coordinating Group - Simulators and Training Devices, worldwide staffing of Training Device Requirements, and the co-location of the Office of the Army Project Manager for Training Devices (PM TRADE) and the Naval Training Equipment Center (NTEC). The technology/devices developed within this Program normally progress to Non-Systems Training Devices (NSTD) Advanced Development (PE 6.37.38.A) and/or NSTD Engineering Development (PE 6.47.15.A). Related Program Elements are 6.27.22.A, Army Training Technology; 6.22.05.F, Training and Simulation Technology; 6.27.57.N, Training and Human Engineering Technology.

H. (U) WORK PERFORMED BY: In-house development is performed by the Project Manager for Training Devices, Orlando, FL; Naval Training Equipment Center, Orlando, FL; United States (US) Army Armament Command, Dover, NJ; and Letterman Army Institute of Research, Presidio, San Francisco, CA. Primary contractors have not been determined at this time.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Initiated work on the Army Maintenance Training and Evaluation Simulation System (AMTESS) by awarding four competitive contracts for the preliminary system engineering design of competitive technical approaches. Successfully completed four preliminary designs for the Automatic Weapons Effects Simulator (AWESS) for caliber

Program Element: #6.27.27.A Title: Non-Systems Training Devices (NSTD) Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

.50 and 7.62mm machine guns. Completed Squad Weapons Analytical Trainer (SWAT) exploratory prototype development and delivered the prototype for testing. Completed the Tank Appended Crew Evaluation Device (TACED) exploratory development and user concept feasibility test. One of the two alternative approaches for wide angle visual displays was successfully demonstrated. The design and fabrication of the other approach was essentially completed. Successfully completed the preliminary design of the Integrated Optics Laser Device which is designed to provide on eye-safe laser range-finder for training. The capability of the Multiple Integrated Laser Engagement System (MILES) engagement simulation system was extended by establishment of concept feasibility for both helicopter and fixed-wing systems and air defense weapon systems. Initial efforts to define parameters of an engagement simulation exercise command and control system for use with the MILES were completed.

2. (U) FY 1980 Program: The preliminary systems engineering design of four Army Maintenance Training and Evaluation Simulation System (AMTESS) approaches will be completed, and up to two conceptual approaches will be selected to enter the breadboard prototype phase. A program will be developed to investigate the feasibility of electronically simulating a large Flat Panel type trainer for use in the preparation of the design specifications for the AMTESS interactive display components. Cooperative efforts with the Air Force in the development and evaluation of a High Detail Daylight Display for Nap-of-the-Earth flight training are planned. Continue research on Computer Generated Imagery (CGI) with the effort directed toward the development of feasible technical approaches for multiple viewpoint CGI display. The Automatic Weapons Effects Simulation System (AWESS) will be expanded to include area weapons normally employed by the combat arms teams. The Integrated Optics Laser System concept study will continue with emphasis on the fabrication of a full up prototype for test and evaluation. The Laser Eye Safety Study, conducted in conjunction with the Letterman Army Institute of Research, will be concluded with the documentation of test results and establishment of safety parameters for use of the MILES equipment. The Engagement Simulation Exercise Control system effort will proceed based on the findings of the MILES Operational Test. Feasibility testing of the 360-degree annular camera probe lens will be demonstrated. The Squad Weapons Analytical Trainer (SWAT) will be tested and the results of the design effort coupled with the test results will provide the technical and operational foundation for the preparation of requirements documents for the follow-on Engineering Development.

3. (U) FY 1981 Planned Program: The preliminary systems engineering design effort of the Army Maintenance Training and Evaluation Simulation System (AMTESS) concept will conclude with the delivery of a design for test and evaluations by the proponent schools. The results of the test and training effectiveness analysis will provide the technical and operational base for the generation of requirements documents and follow-on Engineering Development (ED). The program designed to electronically simulate a Flat Panel Trainer will continue with emphasis on the cost/effectiveness evaluation of demonstrable models. The results of this program will provide technical support for the display components of the AMTESS. The Computer Image Generation effort will continue with the development of demonstrable models. The results of these technology efforts will provide technical support for the preparation of design specifications for crew type visual displays. A hybrid for an

Program Element: #6.27.27.A Title: Non-Systems Training Devices (NSTD) Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

interactive visual scenes generation technique will be initiated with the Naval Training Equipment Center. The hybrid approach will add a new dimension to visual technology that will find application in both aircraft Flight Simulator and ground-based crew weapons systems. Continue the Area Weapons Program designed to investigate low cost, technically feasible weapons signature effects for mine, mortar, nuclear, biological, and chemical (NBC), and cannon artillery system will be continued. The resulting simulator will be interoperable with the MILES sensor. The Engagement Exercise Command and Control Effort will continue with emphasis on development of a data transmission and display system to augment the MILES system. The laser marksmanship program will be concluded with the delivery of design and cost parameters for the utilization of the MILES transmitter for both marksmanship and gunnery training. Programs are planned for the development and evaluation of feasible concepts for the simulation of the dirty battlefield effects for use in Engagement Simulation Exercises. A program will be initiated in the area of a programmable target capable of being inserted into a lower resolution background scene. These techniques will provide for more accurate target identification at lower cost. The High Detail Daylight Display cooperative effort with the Air Force will continue with emphasis on the utilization of the Sodem value as a means to provide high detail.

4. (U) FY 1982 Planned Program: Programs in the areas of Engagement Simulation Command and Control Systems, Laser Marksmanship, Area Weapons Effects, Maintenance and Fidelity of Electronic Interactive Flat Panels will be carried to completion and Training Device Requirements Documents prepared, if warranted. Cooperative programs with both the Air Force and Navy will continue with the emphasis upon the establishment of a sound data base in the visual technology area. Continuation of the Computer Image Generation program with the Navy will provide demonstratable modules for evaluation. A multiple phase program will be developed for those high priority weapons systems identified by the study effort. Continued emphasis will be given to cooperative efforts with the Air Force, Navy, and Army Research Institute in the development of programs that are designed to enhance and reinforce both individual and team training. Programs will be initiated in the areas of built-in diagnostic test equipment and Automatic Test Equipment. These programs will be designed to develop data for use in projecting the field maintenance requirement of advanced weapons systems.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.27.30.A
DOD Mission Area: #523 - Engineering Technology (ED)

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

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3072	3620	4601	4676	Continuing	Not Applicable
AT42-A	Combat Operations Support	511	730	1084	1026	Continuing	Not Applicable
AT42-B	Combat Development Support	1215	1608	2032	2109	Continuing	Not Applicable
AT42-C	Cold Regions Maintenance/ Operations of Facilities	415	408	495	541	Continuing	Not Applicable
AT42-D	Cold Regions Design and Construction	931	874	990	1000	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objectives of this program are: (1) to insure that the Army is capable of successfully conducting combat operations in both a winter temperate zone and an extreme cold environment; Soviet block nations are far ahead in winter combat capability and expect winter conditions to eliminate NATO technological advantages; (2) to develop and evaluate methods of identifying the aspects of terrain, climate, and adverse environmental conditions which constrain the design and performance of advanced electro-optical weapon/targeting systems particularly on a winter battlefield and (3) to develop cost effective techniques and engineering criteria for the construction, operation and maintenance of permanent Army facilities in areas where cold weather presents a costly operation and maintenance penalty.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: The FY 1981 request is based on requirements that support the development of employment concepts and doctrine by the Army Engineer Center and School, Combat Development Center and Operational troop units, the Department of Army Materiel Development and Readiness Command (DARCOM), and the military construction, operations and maintenance mission in cold climates being studied by the Corps of Engineers. The first requirement is to provide a winter combat capability which will insure that US forces can maintain their effectiveness in the adverse cold environment of northern Europe. The second

Program Element: # 6.27.30.A Title: Colds Regions Engineering Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

requirement is concerned with the development of criteria an operating characteristics required to design weapons and equipment employed in winter warfare and under the other adverse conditions. The highest priority items in the area include solutions to the problem of icing on combat helicopters and other military equipment and insuring that weapon targeting systems remain effective in blowing snow, dust and winter fog. The third requirement is to provide a marked reduction in the costs to operate and maintain military facilities in cold regions (northern US, Alaska, Korea, Europe). Operation and maintenance costs at Army facilities in cold climates currently average $33 million above comparable costs for temperate zone facilities. An estimated $50 million is spent annually in construction to replace prematurely failed weapon targeting systems remain effective in blowing snow, dust and winter fog. The third requirement is to provide a marked reduction in the costs to operate and maintain military facilities in cold regions (northern US, Alaska, Korea, Europe). Operation and maintenance costs at Army facilities in cold climates currently average $33 million above comparable costs for temperate zone facilities. An estimated $50 million is spent annually in construction to replace prematurely failed weapon targeting systems remain effective in blowing snow, dust and winter fog. The third requirement is to provide a marked reduction in the costs to operate and maintain military facilities in colds regions (northern US, Alaska, Korea, Europe). Operation and maintenance costs at Army facilities in cold climates currently average $33 million above comparable costs for temperate zone facilities. An annually in construction to replace prematurely failed roofs, pavements, etc.

D. (U) BASIC FOR CHANGE BETWEEN FY 1981 AND 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to completion	Total Estimated Costs
RDTE					
Funds (current requirements)	3072	3620	4601	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	3072	3677	4641	Continuing	Not Applicable

Minor internal program adjustments resulting in decrease in FY 80 funds ($57) and FY 81 ($40) will reduce work on maintenance/operations and design/construction of facilities in Cold Regions.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: # 6.27.31.A
DOD Mission Area: #523 - Engineering Technology (ED)

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

(5) completion of field tests of an initial system to evaluate architectual designs for conformance with design criteria. Accomplishments to increase productivity in the operation and maintenance of military facilities included: (1) development of plans and specifications of the Facilities Engineers master plan in order to define the scope of the Computer-Aided Facility Engineer Management Systems; (2) incorporation of a pavement condition rating procedure into the Pavement Maintenance Management Systems; and (3) completion of shop moderization guidance for twelve types of maintenance shops. Accomplishments to develop rapid and mission-oriented construction in the theater of operations included: (1) completion of prototype development of small field shelters using foam as a rapid means providing protection for command, control, and communication positions; (2) completion of cost analysis studies on pre-fabricated panels (insulated metal) vs field-erected panels as an alternate to conventional stud-frame construction; (3) completion of the performance requirements evaluation for an engineer combat vehicle; and (4) development of functional design information reflecting requirements for Prepositioning of Material Configured to Unit Sets (POMCUS) storage sites to be used by planning teams on specific future POMCUS sites.

2. (U) FY 1980 Program: The major research activities to improve the military construction process include: (1) completion of performance evaluation testing of the initial system to evaluate architectual designs for conformance with design criteria (SEARCH) and transfer the system to a Corps of Engineers accessible computer; (2) completion of prototype testing of the computer-aided system (EDITSPEC) to assist engineers in preparing project specifications; (3) adding storm sewers and electrical distribution systems to the interactive computer program for analyzing military installation utility system capacity; (4) completion of a Technical Manual including guidance for evaluating proposals and design review on the use of industrialized building systems in the military construction process; (5) evaluating commercially available hardware and software for use in conjunction with the computer-aided final design cost estimating system to provide a data file for accurate pricing information; (6) development of quality control techniques for the design and construction of low sloped roofs; (7) development of interim life-cycle cost data base to be used by District designers and planners; (8) development of procedures to screen and evaluate existing facilities for earthquake resistance and provide guidelines to upgrade essential facilities; and (9) development of equipment to detect flaws in welds which may occur during automated welding. Research activities to improve productivity in the operation and maintenance of military facilities include: (1) development of a master plan for the Facility Engineer Management System; (2) development of necessary technology to improve the management and use of single and multiple unit military housing; (3) construction of experimental roofs at three Army installations using propylene and polyurethane foam, and single-ply roof systems; and (4) evaluation of roof repair materials and procedures to develop an effective technique for repair and maintenance of low slope roofs. Research to develop rapid construction techniques for the theater of operations include: (1) new and innovative concepts for ammunition storage to provide better storage in the theater of operations; (2) fielding welding criteria for aluminum alloys used in construction of bridges in the theater of operations; (3) evaluation of polyurethane foam as a cold weather construction material that will permit rapid construction of protective structures; and (4) establishing criteria for siting and layout of POMCUS Facilities.

Program Element: # 6.27.30.A
DOD Mission Area: #523 - Engineering Technology (ED)

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

F. (U) DETAILED BACKGROUND DESCRIPTION: The US Army Cold Regions Research and Engineering Laboratory (CRREL) provides centralized management for this project. In conjunction with CRREL, research is conducted by the US Army Engineer Waterways Experiment Station (WES) and the US Army Engineer Topographic Laboratories (ETL). Research is being conducted in four areas to: (1) provide US forces with a winter combat capability so that winter conditions can be used to advantage rather than becoming a crippling disadvantage; (2) overcome environmental constraints on materiel and provide equipment that will work as intended in a cold battefield environment; (3) maintain and operate Army facilities in northern areas where winter conditions require different methods and techniques; and (4) develop new design requirements for rehabilitation of existing northern Army facilities to reduce the current energy and maintenance cost penalty attributable to winter conditions. These tasks require a coordinated research approach to solve the problems that cold weather causes on Army facilities, materiel, operations and maintenance. This program represents a unique Army research investment in the problems associated with cold/regions.

G. (U) RELATED ACTIVITIES: Related programs are the Civil Works Research and Investigation programs on cold regions hydrology, ice engineering and management of land treatment of wastewater. Program Element 6.11.02.A, Defense Research Sciences, Project AT24, Snow Ice Frozen Soil; Program Element 6.27.31.A, Military Facitilities Engineering Technology, Project AT41, Military Facilities Engineering Technology; Project A896, Environmenal Quality for Military Facilities; and Program Element 6.21.11.A, Atmospheric Investigations. Direct and continous coordination is maintained by CRREL with the US Army Construction Engineering and Research Laboratory (CERL), the US Army Waterways Experiment Station (WES), and the Atmospheric Sciences Laboratory (ASL) to preclude duplication of effort.

H. (U) WORK PERFORMED BY: Approximately 89 percent of work is performed in-house by the US Army Cold Regions Research and Engineering Laboratory, (CRREL) 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 Army Engineer Topographic Laboratories (ETL) Fort Belvoir, VA; the US Army Engineer Waterways Experiment Station (WES), Vicksburg, MS; the US Army Facility Engingeer Support Agency, Ft. Belvoir, VA; and US Army Engineer District, AK; US Army Engineer Division, North Pacific Division, North Central Division, Missouri River Division and North Atlantic Division. The performing agencies also contract for research support; contractors include the University of Alaska, College, AK; Colorado State University, Ft. Collins, CO; RAMCO Inc., Arlington, VA; and Man-Tech Corp., NJ. Direct and continuous coordination is maintained between CRREL, WES, and ETL.

I. (U) PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. (U) FY 1979 AND Prior Accomplishments: Reports on ballistic attenuation in snow and fragment penetration in frozen soil have been completed. Techniques for construction of snow fortifications which provide superior protection in shorter time than either standard US methods or current Soviet techniques have been developed and distributed to the user. A troop test was Program conducted with the 172nd Brigade in Alaska to demonstrate the effectiveness of snow fortifications against Soviet weapons. A new

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mortar baseplate has been developed resulting in an improved lightweight 81 mm mortar baseplate of superior performance. A series of 10 handbooks has been issued to provide criteria for design and testing on cold weather environments by the Development and Readiness Command (DARCOM). Performance data have been assembled to evaluate and improve the design of intrusion sensors in cold regions. Information now on hand is only beginning to show how unreliable sensor systems are in frozen ground and snow. An environmental data base is being developed so that designers of major weapon systems can assess the risk on cost of designing to specific performance levels in hostile environments. Methods are being developed for detection systems to describe the specific performance levels in any environment. Sensing and detection systems are being developed to describe the interaction between eletro-magnetic radiation and natural terrain materials in support of battlefield obscuration cold regions research. Research feedback was obtained from Alaska exercise Jack Frost and European REFORGER exercise as a result of direct participation by the US Army Cold Regions Research and Emergecy Laboratory (CRREL) pesonnel. One of the most serious problems is in placement, use and retrieval of ribbon bridges in winter. Laboratory tests and field trials were conducted on foundations, quick curing low temperature concrete, utility distribution systems and pavements. This research was translated into construction criteria with the issuance of Technical Manual (TM) 5-852-4 "Arctic and Subarctic Regions", TM 5-818-1, Chapter 18 "Design of Foundations in Areas of Significant Frost-Penetration" and "Cold Climates Utilities Delivery Systems". Soil and permafrost investigations were conducted along the Trans-Alaska pipeline to validate design data and criteria developed in this program for foundations, slopes, roads and airfields. Initial observations were taken along the pipeline route to establish a base for long term performance surveys of thaw-consolidation and settlement of pilings. Resistivity surveys made in Alaska demonstrated the use of the technology to locate permafrost, and underground water resources, identify soil type and bedrock with particular emphasis on grounding and cathodic protection potential. Much of this technology in construction of the new Alaska natural gaseline. A methodology using infrared equipment to detect moisture saturated insulation in roofs was developed. Substantial savings here resulted for example, at Ft. Eustis, VA, where $165,000 was saved on one roof alone.

2. (U) FY 1980 Program: There are four planned major research activities in FY 1980. Two are new starts and two are a refocusing of on-going research. Specifically, the capability of weapons systems to operate effectively under conditions of dust, snow, blowing snow and winter fog, is uncertain. Research will be initiated to characterize the winter battlefield environment. A major field exercise, SNOW I, will be conducted with participation by CRREL, the Engineer Topographic Laboratories, and the Atmospheric Sciences Laboratory to establish the electromagnetic characteristics of blowing snow and snow covered terrian and to determine the attenuation of sensor systems. The second start is to develop engineering techniques which can be employed by the combat engineer on the winter battlefield to achieve an advantage; i.e., techniques for using winter fog and snow as camouflage, frozen rivers as ice bridges, compacted snow as helipads and for creating river/lake ice jams as barriers. This program is being developed with the US Army Engineer Center and School to determine the most important current shortfalls in winter combat. On-going research efforts also are focused on developing criteria which will: (1) drastically reduce the annual cost of repairing Army roads and paved areas due to frost damage; (2) improve techniques to rehabilitate Army buildings in winter areas where temperate zone criteria fail to provide cost-effective operations; (3) determine the reliability of water and waste treatment

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systems in cold regions; (4) establish a base line study for more cost-effective maintenance. Emphasis will also be placed on research to reduce operations and maintenance costs of Army facilities stressing conservation of energy. FY 80: In-house $3.253M, contractual $0.367M. Number of civilian personnel supported with requested FY 80 funds: Professional 40; Support 47.

3. (U) FY 1981 Planned Program: The FY 81 program will continue with emphasis on improving the thermal performance and moisture resistance criteria of military facilities to conserve energy and reduce operations and maintenance costs in cold regions. The FY 80 base line research in operation and maintenance of Military Facilities in cold regions offering the optimum savings will be completed. Research will be concentrated on "dirty battlefield" problems. The impact of natural and man-made environmental conditions on the operating effectiveness of Army weapons systems will be determined. Other combat engineer oriented studies will concentrate on the development of techniques for bridging frozen rivers, the rapid repair of airfields during periods of low temperature, the performance of mines and counter-mine detection in snow, ice and frozen soil, and the performance of ground vehicles operating in thawing soils. FY 81: In-house $3.950M, Contractual $0.651M. Number of civilian personnel supported with requested FY 81 funds: Professional 52; Support 60.

4. FY 1982 Planned Program: Changing DOD requirements in the economic and strategic area of the far North will be reviewed and where necessary research directed to meet these needs. New work in foundations, utilities and pavements will begin with the construction of the Frost Effects Research Facility. The emphasis on the winter battlefield will remain very strong with continuation of bridging, mobility, and mines and countermines research. A study will be initiated to develop techniques for sub-surface exploration and emplacement of weapon systems.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.27.31.A
DOD Mission Area: #523 - Engineering Technology (ED)

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

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3000	2991	4236	4288	Continuing	Not Applicable
AT41	Military Facilities Engineering Technology	3000	2991	4236	4288	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides military standards for obtaining affordable facilities for Army in garrison as required for readiness mission. This program element is essential to support the planning, design, construction and maintenance of Army facilities worldwide. It is directed to providing the technology to increase productivity and quality in the planning, design, construction, and maintenance of Army facilities in temperate and tropical climates. The objectives of this program are to reduce costs without degrading quality in the construction of Army installations; to provide more cost-effective facilities from the standpoint of life-cycle costs; and to decrease the logistics required and the skill levels necessary for troop construction of facilities in the theater of operations.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: To develop technology to increase productivity of the master plans, design, construction, and operations, maintenance of permanent military facilities as well as rapidly constructed, economical and easily constructed facilities in the theater of operations. The systems and products under development include master planning procedures for consistency and cost-effectiveness; design review systems to insure complaince with criteria; evaluation of techniques for systems building acquisition procedures in the military construction process; non-destructive testing techniques for better quality control during construction; management information systems for the facilities engineer, and the application of new materials and techniques for the theater of operations construction.

Program Element: # 6.27.31.A
DOD Mission Area: #523 - Engineering Technology (ED)

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

D. (U) BASIC FOR CHANGE BETWEEN FY 1981 AND 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to completion	Total Estimated Costs
RDTE					
Funds (current requirements)	3000	2991	4236	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	3000	3000	3759	Continuing	Not Applicable

FY 1980 funds decrease result from Congressional - mandated payment of distribution cost associated with personal services contracts. FY 1981 increase caused by adding funds to support development of a model of combat engineering activities for evaluating the effectiveness of the Engineer Combat Mission.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 6.27.31.A
DOD Mission Area: #523 - Engineering Technology (ED)

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

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objectives of this program are: (1) to increase productivity and quality of Army resources required to master plan, design, construct, operate, and maintain permanent installations; (2) to minimize the life-cycle costs of the Army facilities; and (3) to develop facility designs for troop construction requiring less time and fewer skill levels in the theater of operations. The research is being directed toward four major thrust areas: (1) to develop systems which will provide Army personnel in all stages of military construction with tools and techniques at minimum cost; (2) to develop systems which will maximize effectiveness in resource allocation to operate, maintain, and repair existing facilities; (3) to develop and evaluate alternatives to high-cost construction materials, complex construction systems, construction quality control, and repair and maintenance techniques used in facility operations; and (4) to develop material systems and construction techniques for rapid construction in the theater of operations.

G. (U) RELATED ACTIVITIES: This project is coordinated Service-wide through the Joint Service Civil Engineering Research and Development Coordinating Group, the Tri-Service Committee on Protective Coatings, and the Intergrated Facilities System Project Advisory Group. Coordination with intergrovernmental agencies is accomplished through the Joint Services Building Materials Program with National Bureau of Standards, Modular Intergrated Utility Systems with the Department of Housing and Urban Development, and participation in the National Academy of Sciences Building Research Advisory Board. Related Programs include: Program Element 6.11.02.A, Defense Research Sciences, Project AT23, Basic Research in Military Construction, US Army Engineer Construction Engineering Research Laboratory, Champaign, IL; Program Element 6.27.19.A, Engineering Technology (ED), Project AT40, Mobility and Weapons Effects, US Army Engineer Waterways Experiment Station, Vicksburg, MS; Program Element 6.27.20.A, Environmental and Life Sciences (ED), Project A896, Environmental Quality Technology, US Army Engineer Construction Engineering Research Laboratory, Champaign, IL; and Program Element 6.27.81.A, Engineering Technology (ED), Project AT45, Energy Technology Applied to Military Facilities, US Army Construction Engineering Research Laboratory, Champaign, IL.

H. (U) WORK PERFORMED BY: Approximately 65 percent of project funds are used for in-house effort at the US Army Engineer Construction Engineering Research Laboratory.

I. (U) PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. (U) Accomplishments: Improvements to the Military Facilities planning design and construction, process, included: (1) the development of a Computer-Aided DD Form 1391 Processor and the transfer of this system to this Huntsville Division for major command training and operational use; (2) the development of an interactive computer program for analyzing water supply and sanitary sewer system capacities for new construction and rehabilitation on Army installations; (3) participation in the development of an effective interface between the Construction Research Council and the Army in procurement procedures for industrialized building systems; (4) participation in the demonstration of an operating Prototype Project Description Data Handling System (PPDDHS) as a module for the integrated Computer-Aided Engineering and Architectual Design System (CAEADS); and

Program Element: # 6.27.31.A Title: Military Facilities Engineering Technology
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3. (U) FY 1981 Planned Program: Planned program activities to improve the military construction process will include: (1) development of evaluation procedures to allow consideration of systems building technology in the Army construction cycle; (2) establishment of procurement procedures to allow the Corps of Engineers to use systems building technology; (3) adapting a system for automatically drafting construction drawings from architectural design information input; (4) development of technical specifications for microprocessors applied to develop construction management productivity; (5) establishment of control limits on welding construction steels to improve quality of weld in the field; (6) development of a selection guide on non-destructive testing techniques to provide quality control during the construction process; (7) development of a model to quantify the distribution of MCA funds for force-readiness planning; and (8) adapting a data base management system to generate lists of military construction design guidance. Research activities to improve productivity in the operation and maintenance of military facilities will include a set of standard procedures for the management of military housing. Scheduled research for rapid construction in the theater of operations will include: (1) recommendations on the use of indigenous construction materials in the theater of operations; (2) development of the recommendations on engineer tool sets; (3) development of recommendations for changes to the Table of Organization and Equipment (TO&E) for real property maintenance to improve effectiveness and increase productivity of engineer organizations in the theater of operations; (4) development of designs for the Army Facilities Component System (AFCS) storage facilities; and (5) development of performance specifications for POMCUS storage facilities to resist chemical/biological attack. Number of personnel supported by FY 81 funds: Professional 36; Support 18.

4. (U) FY 1982 Planned Program: Planned research efforts to improve the military construction process will include the development of: (1) an architectural design system to provide construction documents generated from input design criteria; (2) corrosion control selection guide for water treatment cathodic protection; (3) criteria for use of plastics in construction to reduce the effects of corrosion; (4) design guidance on the use of plastic for structural applications in military construction; (5) data base and data collection procedures for permanent life-cycle cost projects; (6) a checklist to assist planning engineers in ascertaining users' needs in facility design; and (7) field tests of quality control techniques for flat roof construction at Army installations. Research to increase the productivity in operation and management of military facilities will include: (1) field testing the Computer-Aided Facilities Engineering Management System; (2) evaluating experimental construction and performance of flat roof systems incorporating propylene and polyurethane foam single-ply roof systems; (3) development of guide specifications for the repair of low-slope roofs on the most effective methods and materials to increase the operational life of the roof system; and (4) development of a corrosion survey and evaluation system. Research activities addressing rapid construction in the theater of operations will include development of: (1) designs for the Army Facilities Component Systems (AFCS) maintenance facilities; and (2) functional requirements and design criteria for decontamination facilities for POMCUS site personnel and equipment.

Program Element: # 6.27.31.A
DOD Mission Area: #523 - Engineering Technology (ED)

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

5. (U) Program to Completion: This is a continuing program. Improvements to the military construction process will include development of: (1) the entire System to Evaluate Architectural Design (SEARCH); (2) design criteria for concrete structures to resist earthquakes; (3) the preliminary design cost estimating system; (4) the corrosion control management information systems; (5) the totally automated weld quality assurance system; (6) interface of the corrosion control management information system with existing Army management systems; and (7) welding limits for welding stainless steel. Research to improve productivity in operation and maintenance will include: (1) the development of cathodic protection for steel structures by hybrid systems; (2) completion of development of an automated housing information system; and (3) the development of a preventive maintenance program for low-slope roofs. Accomplishments for rapid construction in the theater of operations will include the development of: (1) an engineer performance guide which produces work rates for combat troop resources; (2) performance specifications for neutron attenuation composite materials; and (3) material and design criteria for use of foams to provide deliberate and rapid erection of protective structures in the theater of operations.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.32.A
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)

Title: Remotely Piloted Vehicles (RPV) Supporting Technology
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1100	2744	2813	2976	Continuing	Not Applicable
AF 34	Remotely Piloted Vehicle Supporting Technology	1100	2744	2813	2976	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is to develop technological capabilities in those areas which currently limit the operational potential of small RPV's for Army missions of Target Acquisition, Designation and Aerial Reconnaissance (TADAR), and for future missions. RPV's are required to 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. Growth capabilities, cited in the requirements document for the TADAR mission, needing further development include extended range, multiple control, and eyesafe lasers (for training). This project will define and develop those capabilities. Other activities include development of night and all-weather sensors, Air Traffic Control/Identification Friend or Foe (ATC/IFF) devices, automatic cuers and intelligent bandwidth compression devices, survivability/vulnerability, and study of future missions; e.g., relay, decoy, and radiac survey. These exploratory development efforts will enhance the mission effectiveness of small RPV's, improve system reliability, and reduce life-cycle costs, wherever possible.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Funds requested provide for completion of the fabrication of the prototype ATC/IFF device for mini-RPV's, initiation of the fabrication for a prototype multicontrol antenna to satisfy TADARS growth requirements, miniaturization of components for a millimeter radar, and initiation of development for a focal plane array FLIR and automatic cuer/intelligent bandwidth compression equipments. Funding will also be provided for investigation of future mission configurations and for improved propulsion systems.

Program Element: #6.27.32.A
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)

Title: Remotely Piloted Vehicles (RPV) Supporting Technology
Budget Activity: #1 - Technology Base

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1980 Submission
Complete miniaturized ATC/IFF device	September 1981	Not shown
Start fabrication of multicontrol antenna	January 1981	Not shown
Start of miniaturization of millimeter components	October 1980	Not Shown
Begin fabrication of focal plane array FLIR	December 1980	December 1979
Begin development of intelligent autotrackers and bandwidth schemes	November 1980	November 1980

Fabrication of the focal plane array Forward Looking Infrared (FLIR) has been deferred for 1 year because the technology is not considered sufficiently mature at this time to adapt to a mini-RPV.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1100	2744	2813	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	1100	2744	2899	Continuing	Not Applicable

FY81 funds restructured to fund higher priority requirement.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.32.A
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)

Title: Remotely Piloted Vehicles (RPV) Supporting Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of the Army RPV program is to field mini-RPV systems which have high reliability and which are cost-effective for selected missions. The first priority Army mission is Target Acquisition, Designation, and Aerial Reconnaissance (TADAR). The first generation system will provide day mission capabilities via a fixed-wing mini RPV under command from a Ground Control Station (GCS). The Engineering Development (ED) contract for TADAR was awarded in August 1979 and the ED contract for the GFE data link (Modular Integrated Communications and Navigation System--MICNS) was awarded in May 1979. The Engineering Development Programs are structured to accommodate growth, most notably a night mission capability Forward Looking Infrared (FLIR), multiple control and other modular payloads. Alternate missions are being considered, including electronic warfare (both communication and noncommunication jamming), relay, decoy, and radiac survey. This exploratory development program addresses the growth capabilities for the TADAR mission, as well as the future mission configurations. Analysis, simulation, and limited testing is conducted so that subsystems/payloads essential to the complete RPV system can be selected and optimized. Five areas of investigation are being pursued: Air mobility (survivability, propulsion, and launch/recovery), radar (millimeter), missions, command and control (multiple control, extended range, and out of line-of-sight), and electro-optics (low-cost FLIR's, lasers, and autotrackers).

G. (U) RELATED ACTIVITIES: Within the Army, Advanced Development is conducted under Program Element (PE) 6.37.25.A, Remotely Piloted Vehicles (RPV)/Drones, and Engineering Development of the first generation RPV is being conducted under PE 6.47.30.A, Remotely Piloted Vehicles. The Air Force RPV programs consisting of PE 6.37.39.F, Advanced RPV's, and PE 6.47.46.F, Expendable Drones, are being monitored. The Army and Air Force RPV program managers meet periodically to assure cooperation between the Services. A Memorandum of Understanding (MOU) with the United Kingdom was initiated in FY 1979 and opportunities for interoperability between the fixed- and rotary-wing systems are being examined.

H. (U) WORK PERFORMED BY: The Research and Technology Laboratories, Headquarters, Moffett Field, CA; and the Applied Technology Laboratory, Fort Eustis, VA; US Army Electronics Research and Development Command, Fort Monmouth, NJ; Night Vision and Electro-Optics Laboratory, Fort Belvoir, VA; US Army Avionics Research and Development Activity, Fort Monmouth, NJ; and the US Army Human Engineering Laboratory, Aberdeen Proving Ground, MD. Contractors expected to participate are: Norden, Norwalk, CT; Systems Planning Corporation, Washington, DC; Developmental Sciences, Inc., City of Industry, CA; RCA, Burlington, MA; and Calspan, Buffalo, NY.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: This was a new program in FY 1977 and the bulk of funding was directed toward the development, fabrication, and ground testing of an anti-jam data link, the Integrated Communication and Navigation System

Program Element: #6.27.32.A
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)

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Budget Activity: #1 - Technology Base

(ICNS) built by the Harris Electronics Corporation. This system was subsequently integrated into two AQUILA RPV's and flight tested in FY 1978 at Fort Huachuca, AZ, under PE 6.37.25.A, Remotely Piloted Vehicle Drones. Two contracts were awarded to Teledyne Continental and to Bennett Aerotechnical in FY 1977 for the development of two cylinder engines with nominal 20 HP output. In-house analyses (by the Applied Technology Laboratory, Aviation Research and Development Command) of visual and radar signature of RPV's as well as a study of manufacturing techniques for airframes, were completed in FY 1977. The Army Required Operational Capabilities (ROC) for the Target Acquisition, Designation, and Reconnaissance System (TADARS) stated that multicontrol was a growth consideration for the data link and that the night vision capability was a growth requirement for mission payloads. As such, in-house studies of multiple-control option within the Ground Control Station (GCS) and antenna configuration options were initiated in FY 1978. An in-house draft report of future mission opportunities for mini-RPV's was completed in FY 1979, and a contract study (cofunded with PE 6.37.25.A) was awarded to Systems Planning Corporation to better define multicontrol options. Two contracts were awarded in FY 1978 (Ford Aerospace and Honeywell) for the modification of a Honeywell POISE gimbal to include 8-12 micron FLIR's and ground testing. The sensor was subsequently modified to enhance recognition ranges. The contracts for engines (awarded in FY 1977) resulted in delivery of hardware to the Government in May/June 1978. Government performance and endurance testing of these engines plus engines from DH Enterprises was completed in FY 1979 and was cofunded with PE 6.37.25.A. Modifications were completed on a 95 Gigahertz millimeter surveillance radar to enable ground testing in FY 1979. Ground-based testing of the millimeter radar was performed at a contractor site and testing at a Government site will continue into FY 1980. Data has been collected on moving and stationary military targets in clutter and, insofar as is possible, in adverse weather conditions. A prototype 2.06 micron eyesafe laser rangefinder program was funded and has demonstrated greater than 2 km range performance against noncooperative targets. Refinements of the eyesafe laser transmitter, detectors, and materials were undertaken in FY 1979. In addition to the foregoing, automatic recovery investigations were conducted and a flight demonstration of one concept was demonstrated in FY 1979, an alternate pneumatic launcher was ground-tested, propellers optimized for performance were fabricated, and acoustic signature characteristics of propellers were statically and dynamically tested in an effort to reduce acoustic observables and thereby increase survivability. A study was initiated with Calspan in FY 1979 to determine if mini-RPV's need to carry Air Traffic Control/Identification Friend or Foe (ATC/IFF) equipments to avoid mid-air collisions as well as to enhance coordination with friendly air defenses.

2. (U) FY 1980 Program: Studies are being initiated to design two alternative antenna configurations (planar and horn) essential to the accomplishment of the multicontrol growth capabilities cited in the Required Operational Capability (ROC). Limited fabrication of selected antenna elements will be included in the contracts. The future mission options for mini-RPV's will be further delineated in collaboration with the user, with special emphasis on relay and decoy applications. A study will be completed in FY 1980 to determine the validity and better define the extended range growth requirements cited in the ROC for the TADARS RPV application. Based on the results of the ATC/IFF Study, and the unavailability of a small lightweight

Program Element: #6.27.32.A
DoD Mission Area: #521 - Electronic and Physical Sciences (ED)

Title: Remotely Piloted Vehicles (RPV) Supporting Technology
Budget Activity: #1 - Technology Base

IFF device suitable for mini RPV applications, fabrication of a prototype miniaturized ATC/IFF device will begin. Refinements to the eyesafe laser rangefinder system will be finished so that testing can be accomplished. The millimeter radar system will complete evaluation through flight testing. In-house evaluation of open and ducted propeller designs as well as in-house survey of engines suitable for growth versions of a RPV will be concluded by the Applied Technology Laboratory.

3. (U) FY 1981 Planned Program: Fabrication of the prototype miniaturized ATC/IFF device started in FY 1980 will be completed. This device will enable mini-RPV's to operate over the division area of interest while minimizing the risk of mid-air collisions with manned aircraft and the risk of being fired upon by friendly air defenses. Key components essential to the miniaturization of the millimeter radar (target weight of 50 pounds) will be fabricated. Emphasis will be to develop small, lightweight, low-power drain, and inexpensive components tailored to the requirements of the mini-RPV. In particular, the following will be developed over the FY 1981-83 period: A duplexer with solid-state devices for single antenna operation on transmit and receive, a radar signal processor and receiver that will permit the use of low-power solid-state sources, a modulator and source consistent with pulse compression techniques, and digital circuitry for implementation of the fixed target enhancement algorithm. Fabrication of the multicontrol antenna essential to multicontrol requirements stated in the TADARS/MICNS contracts and the ROC will begin in FY 1981. The antenna configuration (planar array or horn) will be selected through review of the design studies in FY 1980. Major considerations in the selection of the multicontrol ground antenna include: Definition of data link requirements for nontarget acquisition missions, determination of navigation/range requirements, mission definition, and sector coverage requirements. A contract will be awarded in FY 1981 for the design and development of a focal plane array Forward Looking Infrared (FLIR) suitable for usage in a mini-RPV. This second generation FLIR offers size and weight reductions while providing performance improvements. In addition, preliminary design of intelligent autotrackers and bandwidth compression techniques will be started. Hardware will be developed to decompose imagery into descriptors and coordinates for bandwidth compression ratios that can be adjusted adaptively up to 10000 to 1. Intelligent tracker concepts for predicting and anticipating target signatures under changing conditions will be assessed. Investigation of future RPV mission configurations will continue.

4. (U) FY 1982 Planned Program: Miniaturization of key components essential to the adaptation of a millimeter radar to a mini-RPV will continue. The fabrication of the multicontrol ground antenna needed to fulfill TADARS growth requirements will be completed. Investigation and definition of future RPV mission capabilities will continue. Exploratory development of the focal plane array FLIR will be completed. Prototype hardware for autocuers and intelligent bandwidth compression techniques which was initiated in FY 1981 will continue. Ancillary investigations of propulsion, launch, recovery, and survivability equipments will be conducted as warranted by the emerging future uses of these mini-RPV's.

Program Element: #6.27.32.A
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)

Title: Remotely Piloted Vehicles (RPV) Supporting Technology
Budget Activity: #1 - Technology Base

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.33.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Mobility Equipment Technology
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	9459	9981	12188	16759	Continuing	Not Applicable
AH20	Mobility Equipment Technology	9459	9981	12188	16759	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The work under this program is Exploratory Development in the areas of fuel (fossil and synthetic), 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 for vans and shelters; marine equipment; containerization; construction equipment; expedient surfacing and soil stabilization; and physical security. These efforts are required because of 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; antivehicular barriers that require reduced logistical and support burdens; controllable barrier systems that effectively impede enemy units but permit safe passage of friendly forces; tunnel detection means to recognize and classify seismic and acoustic activity associated with underground activities; 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 manpack mode; sufficiently strong, advanced, light-weight mobile bridging structures for Class 70 bridges; highly efficient camouflage techniques for thermal decoys that provide low emissivity in the dark; rapid means for soil stabilization and emplacement of expedient surfacing; 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 survivability; detailed understanding of effects of alternate/synthetic fuels on combat vehicle operations 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. (U) BASIS FOR FY 1981 RDTE REQUEST: Requested funds will provide for the following: Investigation of improved air conditioning systems that provide chemical, biological and, radiological protection for armored combat vehicles; continued work on

Program Element: #6.27.33.A Title: Mobility Equipment Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

low-cost fuel cells, improved tactical electric power distribution, and new air conditioning concepts. Continue 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. Investigate military effectiveness and perform systems analysis of field fortifications. The new major thrust will be continued on high strength, lightweight composites for bridging structures. Continue development of improved methods for supply distribution, excavation, camouflage, explosive and minefield detection and neutralization. Develop and evaluate osmotic membranes for water purification with ability to remove trace turbidity and water detection methods for desert environments. Continue evaluation of coatings and adhesives for seamless water supply tanks. Develop criteria for closed circuit automatic refueling of combat vehicles. Continue to develop and evaluate improved multipurpose antifreeze, high-performance engine oils, high-energy fuels, alternate/synthetic fuels including the evaluation of Gasohol performance in Army equipment, and nonflammable hydraulic fluid for unique Army engines. Accelerate and expand programs to develop means to modify ground combat vehicle fuels to satisfy urgent need for improved fire survivability.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	9459	9981	12188	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	9714	9991	9885	Continuing	Not Applicable

The decrease in FY 1979 was due to requirements to provide support for urgent priority Army programs. The increase in the FY 1981 planned funding will be used to provide support for an expanded program to qualify synthetic mobility fuels for Army vehicles. The decrease in FY80 is the result of a general Congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.33.A Title: Mobility Equipment Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

F. (U) 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 logistics 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 and new barriers and intruder detection devices. It covers exploratory development work to detect and neutralize minefields and 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 work 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. It covers the Exploratory Development of high energy fuels to increase vehicle range and engine efficiency; and the effort towards increasing availability of conventional, alternate and synthetic fuels including the evaluation of Gasohol performance in Army equipment. Finally, it covers water purification systems, containerized, bulk cargo and fuel-handling equipment, logistics watercraft, environmental control equipment, and rapidly emplaced construction materials to provide the support needed to sustain Army mobility and logistics in a hostile environment.

G. (U) 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 provides 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. The fuels and lubricants technical area provides direct support for the Advanced Development Program Element, 6.31.04.A, Fuels and Equipment. Group, and Program Manager for Army Container-Oriented Distribution System.

H. (U) WORK PERFORMED BY: In-house work is performed by United States (US) Army Mobility Equipment Research and Development Command, Fort Belvoir, VA; US Army Engineer Waterways Experiment Station, Vicksburg, MS; Yuma Proving Ground, Yuma, AZ; US Army Armament Research and Development Command, Aberdeen, MD; and Harry Diamond Laboratories, Washington, DC. Contractual support is provided by Southwest Research Institute, San Antonio, TX; SKF Industries, Philadelphia, PA; Energy Research Corporation, Dansbury, CT; Chrysler Corporation, Detroit, MI; Goodyear Aerospace, Akron, OH; and Beckman Industries, Carlsbad, CA. Contracts are planned amounting to $4.5 million.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Established operating conditions for improved organic electrolyte fuel cells. Hybrid power source has been developed and tested to load profiles of electric forklift trucks. Developed and evaluated

Program Element: #6.27.33.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Mobility Equipment Technology
Budget Activity: #1 - Technology Base

silicon carbide fuel cell matrices for increased reaction rate and carbon monoxide tolerance. Continued analysis and tests on improved air-cycle and absorption-cycle air conditioning systems. Completed compressor-expander tests of air-cycle environmental control unit for mobile applications. Completed cost and operational effectiveness analysis of a 120-150-ton air cushion barge for logistics-over-the-shore operations. Fabricated prototype mechanical sandbagger capable of producing 600 bags/hr using a 4-man crew. Surveyed industry for state-of-the-art visibility/safety devices for materials handling equipment. Developed improved bridging concepts, materials and methods for the 1980's. Continued programs on smoke, foam, camouflage, and other methods for reduction of thermal and radar signatures generated by various items of materiel. Evaluated multidisciplinary approaches to long-range detection of remote minefields. Continued evaluation of an off-route buried minefield detector; and a man-portable metal reradiation detector and explosive detector for landmine detection. Defined mass, velocity, and size of selected materials to penetrate soil cover and mine casing to detonate the secondary explosive in land mines. Demonstrated the feasibility of spraying fuel-air explosives (FAE) from a flame-throwing tank. Demonstrated the use of ground-vehicle mounted systems for mine neutralization. Completed systems analysis study of vehicle track and suspension system vulnerabilities for developing barrier entangling devices. Conducted laboratory and field tests to improve stability of foam barriers to weather effects. Continued efforts on improving engine oils and lubricants, issued specification for helicopter spline grease and evaluated long-life automotive/artillery grease. Developed improved antifreeze corrosion inhibitors and extenders for Army vehicles. Designed improved reinforcement system for dry-gap tactical bridge. Developed two fire-resistant fuels for user selection.

2. (U) FY 1980 Program: Start Gasohol testing in Army equipment. Continue effort on simplification, cooling, and modularization of tactical electric power conditioners. Complete performance optimization of improved fuel cell anodes. Develop components for advanced acid electrolyte fuel cells. Assemble and evaluate hybrid power source components. Continue 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 portable detectors. Accelerate work on sprayed fuel-air explosives and vehicles demagnetization for desensitization to proximity mines. Continue program on vehicle tractive entanglement devices for barriers. Investigate new and improved bridging materials for advanced mobile tactical bridges. Continue work on multispectral coatings, and thermal and radar signature suppression for camouflage. Evaluate improved high-speed excavation equipment. Complete initial mine detector sensor utility evaluation; screen existing mine detector sensors for technical opportunities; initiate work for dependable field welding of commercial aluminum for mobile bridges; conduct tests and storage stability of fire-resistant fuels; determine flammability of recycled fire-resistant fuels in engines; field test polyelectrolyte dosage control techniques for reverse osmosis water purification unit.

Program Element: #6.27.33.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Mobility Equipment Technology
Budget Activity: #1 - Technology Base

3. (U) FY 1981 Planned Program: Complete testing of Gasohol in Army equipment. Explore feasibility of use of graphitic intercalation compounds for electric cables for improved field power transmission. Develop components for advanced fuel cell. Continue efforts on stand-off buried mine-field detection and portable mine detectors. Increase level of effort on vehicle component hardening and demagnetization. Continue work on vehicle tractive entanglement barriers. Complete visibility/safety devices evaluation of vibratory dozer blade mechanism, and test of high-pressure exhaust gas explosive kit to aid excavation. Continue smoke, foam, and multispectral coating work. Continue determinations of wastewater reuses and ground water detection and purification. Continue Exploratory Development work of fuel storage tank materials, rapid fuel tank deployment, and closed circuit refueling for combat vehicles. Continue performance evaluation of oil compounded from re-refined base stocks, and high sulfur fuels. Evaluate new power transmission fluids; test fire-safe fuel filter/decontaminators and high energy fuel filter/-decontaminators. Accelerate and expand program on high-strength, lightweight composite bridging components. Perform analysis of critical technical and operational minefield sensor characteristics; develop and evaluate new components for direct oxidation hydrocarbon or alcohol/air fuel cells; evaluate new fuel cell catalysts for Army logistic fuels; coordinate with Army user the design goal effort on camouflage critical items; and complete 8-inch howitzer tactical air camouflage concept analysis. Number of personnel involved: Professional 180; Support 140.

4. (U) FY 1982 Planned Program: Explore modular components for power transmission and distribution, including cables based on previous years' insulation work. Build large-capacity generator to power experimental beam devices. Electrode structures incorporating nonnoble metal catalysts will be optimized for advanced acid electrolyte fuel cells. Combine sensor effectiveness models and military worth models to develop program for remote minefield detection and continue efforts on portable mine detectors. Continue work on defining techniques of armored vehicles to defeat magentic influenced mines. Initiate investigations of advanced high-energy nonlethal interactive barrier elements. Continue to evaluate excavating aids such as fluid jets and explosive kits which use high pressure exhaust gases. Continue to evaluate advanced materials and techniques for future tactical bridging. Expand work on coatings and techniques to camouflage multispectral signatures. Continue investigations of bulk fuel storage container materials. Initiate concept of lubricated-for-life, zero-maintenance bearings for Army combat vehicles; continue development of aircraft gear greases and antifreeze extenders. Determine effects of fire-safe fuel on power, range, performance and maintenance characteristics. Conduct evaluation tests, and develop specifications for high energy fuel, synthetic fuels and synthetic oils for Army vehicles, and complete specification for finished re-refined oil. Conduct program to develop an advanced remote minefield detection system, and complete Exploratory Development of energetic projectiles to defeat delay and area denial mines. Investigate materials for advanced fuel cells, including oxidation fuel cell components and feasibility of hybrid power sources for Army use. Complete design goals for camouflage sensitive items. Complete testing of tensile elements in support of new tactical bridging for the 1980's. Continue program to develop a remote minefield detection system; and initiate an extensive data collection effort on remote minefield detection.

Program Element: #6.27.33.A
DOD Mission Area: #523 - Engineering Technology (ED)
Title: Mobility Equipment Technology
Budget Activity: #1 - Technology Base

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.34.A
Title: Medical Defense Against Chemical Agents
DoD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Addition to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7027	5777	5577	4420	Continuing	Not Applicable
AH26	Medical Defense Against Chemical Agents	7027	5777	5577	4420	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Death, disability and significant decrements in operational combat performance will result from hostile uses of a wide variety of chemical warfare (CW) agents. Effective medical defenses are critical in insuring the survival and combat effectiveness of troops that engage hostile forces employing CW agents. Research is urgently needed to develop improved chemoprotectives, antidotes and chemotherapeutics, particularly for exposures to high concentrations and long-term low level exposures to CW agents, and to develop improved methods for evaluating medical materiels used for decontaminating the skin. Research focus must be on the full range of health effects of exposure to CW agents and include efficacy testing of antichemical drugs. The Army Medical Department was assigned Developer responsibility for this Program in FY 1979. It is managed as an integral portion of the total Army effort in Medical Defense Against Chemical Agents.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: This program complements PE 6.27.72 A, Medical Systems in Nonconventional Environments. It represents the Army Medical Department's response to Congressional and DoD interests in chemical defense. It continues efforts to test and evaluate the safety and efficacy of newly developed chemoprotectives, antidotes and chemotherapeutics.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	7027	5777	5577	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	7027	5796	5846	Continuing	Not Applicable

Program Element: #6.27.34.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Medical Defense Against Chemical Agents
Budget Activity: #1 - Technology Base

FY 1981 cost estimate represents an actual program increase of approximately $1600 over FY 1980. The apparent dollar decrease results from transfer of $1870 for base support of the US Army Biomedical Laboratory to Program Element 6.58.04.A, Major Range and Test Facilities. Beginning FY 1981, these costs will no longer be reimbursed from this Program Element. The requested increase reflects the requirement to develop criteria for establishing optimum dose and administration of therapeutic regimens of new compounds and preparation of preclinical data packages for those compounds for submission to the Food and Drug Administration. The decrease in FY 80 is the result of a general Congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.34.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Medical Defense Against Chemical Agents
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Analysis indicates that hostile forces are tactically and philosophically prepared to employ a wide variety of highly lethal chemical warfare (CW) agents against US troops. These forces have sizable stockpiles of CW agents, varied and sophisticated means of delivery, and a training, organizational and tactical doctrine that suggests they view CW munitions as "conventional" weapons. Use of CW agents by an enemy force will cause deaths, disabilities and decrements in operational performance; thus, effective and timely medical defenses are required to assure the survival and combat effectiveness of troops that engage such enemy forces. Individual protective measures available to US troops are limited, often of questionable efficacy and frequently degrade combat performance. Development of efficacious medical modalities has been limited not only by an incomplete basic science data base, but also by both an absence of validated standards for testing and evaluating (T&E), and a lack of scientific criteria for assessing and comparing T&E data for chemoprotective, antidotal or chemotherapeutic value. The major objectives of this program are to minimize soldier vulnerability to CW agents by developing validated standards for T&E and criteria for assessing and comparing T&E data for medical value that will assure timely and effective development of antichemical drugs for individual soldier use. Prior to FY 1979, US Army Materiel Development and Readiness Command had command responsibility for the total CW defense research and development program, with the Army Medical Department having technical responsibility for the medical aspects of the CW defense program. In FY 1979, the Army Medical Department was assigned developer responsibility for this program. This change in responsibility was prompted by an Ad Hoc review of the chemical warfare/chemical biological defense research and development program, directed by the Deputy Chief of Staff for Research, Development, and Acquisition, that resulted in the recommendation that the medical chemical defense research and development program can most effectively be accomplished if the US Army Biomedical Laboratory is assigned to the command of The Surgeon General. It is managed as an integral and complementary part of the total effort in Medical Defense Against Chemical Agents to include PE 6.27.72.A, Project 875, Medical Systems in Nonconventional Environments; therefore, the intent is full integration of PE 6.27.34.A with PE 6.27.72.A in FY 1982. This integrated program provides the basis for minimizing CW casualties, assuring their rapid return to duty, and, thereby reducing the impact on combat resources.

G. (U) RELATED ACTIVITIES: The basic research in support of this Program Element is conducted under PE 6.11.02.A, Project S10, Defense Research Science. Complementary work under PE 6.27.72.A, Project 875, Medical Systems in Nonconventional Environments, focuses on developing concepts, technologies, resources and systems for the prevention, treatment, evacuation and decontamination of CW casualties. All work is coordinated with quadripartite nations and the US Air Force and US Navy. Investigation of the decrements in individual performance associated with the use of antidotes, using a flight simulator, is a joint effort with investigators at the US Air Force School of Aerospace Medicine. Coordination with other Services is via Ad Hoc Joint Service Chemical-Biological RDTE Requirements Prioritization Committee.

H. (U) WORK PERFORMED BY: Research is performed in-house by the US Army Biomedical Laboratory, Aberdeen Proving Ground, MD. Extramural contracts are with Research Foundation of State University of New York, Albany, NY; and Ash Stevens, Inc., Detroit, MI.

Program Element: #6.27.34.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Medical Defense Against Chemical Agents
Budget Activity: #1 - Technology Base

4. (U) FY 1982 Planned Program: Current plans are to consolidate research efforts of this program with PE 6.27.72.A, Project 875, Medical Systems in Nonconventional Environments, for a more efficient management and utilization of resources. Continue the tests and evaluations of chemoprotectives, antidotes, and chemotherapeutics. Continue exploring and evaluating foreign medical approaches to the prevention and treatment of CW casualties. Continue evaluating therapeutic interventions to ameliorate the respiratory complications of CW agents.

5. (U) Program to Completion: This is a continuing program.

Program Element: #6.27.34.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Medical Defense Against Chemical Agents
Budget Activity: #1 - Technology Base

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Principal accomplishments were: identified and initiated testing and evaluation of the efficacy of pyridostigmine as a primary chemoprotective against nerve agent poisoning; tested and evaluated the use of benactyzine and TMB-4 as potential chemoprotectives; conducted studies to evaluate the effects of anticholinergic drugs on visual system and subsequent impact on soldier performance; initiated studies to test and evaluate the efficacy of 4-DMAP and amyl nitrite alone or in combination with sodium thiosulfate in treating cyanide poisoning; initiated studies to test and evaluate mixtures of polyethylene glycol for value as protective barriers against nerve agents; completed collaborative study with the US Air Force School of Aerospace Medicine to assess the effects of one nerve agent antidote in subhuman primates; initiated studies to evaluate the efficacy of chemotherapeutic intervention on nerve agent-induced alterations in respiration; completed transfer of mission and Biomedical Laboratory from the US Army Armament Research and Development Command to the US Army Medical Research and Development Command; and, established the determinations and findings for an extramural contract program in support of the US Army Medical Research and Development Command's Chemical Defense Program.

2. (U) FY 1980 Program: The objectives of the 1980 program are to: initiate a comprehensive review of testing and evaluating (T&E) procedures in the pharmaceutical industry in order to develop a rational approach to T&E applications in the chemical defense program; initiate development and establishment of standards for testing and evaluating the safety and efficacy of anti-chemical drugs; initiate development and establishment of analytical and scientific criteria for assessing and comparing the T&E data of a given drug for relative chemoprotective, antidotal, or chemotherapeutic value; continue tests and evaluations of pyridostigmine for chemoprotective efficacy; continue testing and evaluating the safety and efficacy of 4-DMAP in animals to support a petition for safety and tolerance testing in volunteer human subjects; continue evaluating the efficacy of drug intervention in alleviating nerve agent induced respiratory complications; conduct tests and evaluations of the efficacy of known skin decontaminants; continue development of assay techniques and materials for assessing the safety and efficacy of skin decontaminants; implement the extramural contract program that supports the medical research objectives of the chemical defense program; and, initiate studies to define and validate foreign medical approaches to the prevention and treatment of CW injuries.

3. (U) FY 1981 Planned Program: The objectives of the FY 1981 program are to: expand tests and evaluations of the safety and efficacy of chemoprotectives, antidotes, and chemotherapeutics; define criteria for establishing the optimum dose and administrative schedule for candidate regimens based on pharmacokinetic data; refine and apply developed assay techniques to the safety and efficacy tests and evaluations of skin decontaminants; continue test and evaluations and begin preparation of the preclinical data packages on pyridostigmine and 4-DMAP for submission to the Food and Drug Administration as investigational new drugs; and define, test, and evaluate methods and standards established in emergency treatment facilities for treating and managing chemical injuries; continue examination, testing and evaluating foreign medical approaches for the prevention and treatment of CW injuries; and continue evaluating the efficacy of various therapeutic modalities in reversing the respiratory complications of nerve agent poisoning. Personnel to be utilized: 136 professional and 56 support.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.46.A
Title: Tactical ADP Technology
DOD Mission Area: #521 Electronic and Physical Sciences (ED)
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	Total for Program Element	4109	5300	9478	9081	Continuing	Not Applicable
A094QO	Military Computer Family	174	318	1354	1417	Continuing	Not Applicable
A094RO	Software Techniques	1601	1829	2682	2088	Continuing	Not Applicable
	Computer Security	0	0	1067	681	Continuing	Not Applicable
A094SO	Teleprocessing Design Center	891	805	895	995	Continuing	Not Applicable
A094TO	Intelligent Terminal Family	246	575	413	560	Continuing	Not Applicable
A094UO	System Management Engineering	213	273	167	236	Continuing	Not Applicable
A094VO	Test Technology	0	0	800	1054	Continuing	Not Applicable
A094XO	Communicative Technology	984	1500	2100	2050	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the technology base for new concepts and advances in technology to meet the presently unsolved problem of survivable, cost-effective, maintainable tactical command, control, and information handling systems for the modern battlefield. This program provides exploratory development in software technology (common programming language, Ada, and software development and maintenance environment), hardware (including a family of computers, peripherals, and intelligent terminals), system engineering technology (protocols, data bases, operating systems), and new technology for data storage and transmission. Modern weapon systems are becoming more lethal and effective and more dependent on automation. This speed and lethality create a strong need for automated systems for command and control. The goals of this project are to provide the necessary technology to enhance effectiveness of automated systems, provide for technology insertion into fielded systems and reduce costs for development, maintenance, and logistic support for automated systems.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: The funds are required to continue specification development and exploratory development for a family of military computers, peripherals, and intelligent terminals to provide technology insertion into command, control, and support systems for the battlefield. The common high order computer programing language Ada, and

Program Element: #6.27.46.A
DOD Mission Area: #521 Electronic and Physical Sciences (ED)

Title: Tactical ADP Technology
Budget Activity: #1 - Technology Base

adequate software support tools will be exploited to reduce costs in software development and maintenance. A secure interface to the ARPANET is essential to provide a means of connecting distant development centers and reduce costs and increase efficiency of handling systems which have classified software modules. Enhancement will be made to the Teleprocessing Design Center to allow test, measurement, and comparisons of new technology for weapons systems. Further work will be performed in improving policies, procedures, and standards for the management of computer resources. This program will also provide Army portion of support for Department of Defense computer security consortium. This project is a restructure from Program Element 6.27.01A, project AH92.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	4109	5300	9478	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	2974	5881	5136	Continuing	Not Applicable

Funding for the Center for Tactical Computer Systems and Army Communicative Technology Office were included in PE 6.27.01, Project AH92 Communications-Electronics in FY 1980 and prior in tasks AH92 B (A-F). In FY79 approximately 1.2 million was reprogrammed for software efforts. PE 6.27.01 was reduced by congressional action in FY80. In FY81, funding has increased by approximately 1.2 Million for software technology to support the common programming language, Ada; 1.4 Million in the communicative technology program: 1 Million to provide Army support to on-going Department of Defense computer security program; and 0.8 Million for technology in test, maintenance, and diagnostic equipment.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.46.A
DOD Mission Area: #521 Electronic and Physical Sciences (ED)

Title: Tactical ADP Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Because the United States Army does not have the same quantity of manpower or weapons as the Soviet Bloc Forces, it must rely on superior weapons and information to compensate. Automation and communication are significant elements of most battlefield systems. These technologies have been improving and expanding at an explosive rate. This rapid rate has caused problems that must be corrected now if the US Army is to field effective systems that are easy for the soldier to use and yet reasonable in cost to support. The goal of this project is to provide affordable technologies that will meet the Army's need in these areas in a timely manner. Objectives are to reduce the cost of development and support of tactical automation and communication systems and to accelerate the fielding and improve the survivability (commonality) of these systems. Automated systems provide greater responsiveness, capacity, and accuracy while at the same time reducing the manual burdens. Problems that must be corrected are in the areas of: software cost and performance, testing, proliferation of incompatible products (computers, terminals, peripheral devices, languages, software tools), reliability and cost of input/output devices, and support of automation (hardware, software, people) after deployment. The approach to correct these problems is to provide technologies for a common compatible family of: computers, transportable software products and tools (including a common high-order language), intelligent peripheral devices (terminals, displays, auxiliary memories, etc.), improved testing equipment and techniques. Systems engineering/integration and test beds for system validation experimentation and integration/interoperability testing must be improved. In addition, technical and training documentation provided to soldiers throughout the Army is presented primarily on paper. The paper delivery, storage, and update is too expensive in terms of cost, maintenance, and time to send to the field, all which adversely affect the readiness of the Army. The quantity of documentation is increasing significantly while the reading level of the soldier is down. A communicative technology exploratory development program is being undertaken to establish feasibility for economic technologies to produce, distribute, and deliver training and technical documentation electronically to the soldier in the field in an easy to understand, effective, and efficient manner, saving both time and money and reducing the Army's reliance on paper. In summary, the Army needs this project in order to achieve a state of readiness that will allow the United States to operate from a position of strength while maintaining reasonable cost levels.

C. (U) RELATED ACTIVITIES: This program provides the exploratory development needed for direct support to: Program Element 6.37.23.A Tactical Automation then to PE 6.47.27 Command and Control. It relates to most battlefield automated systems, particularly command and control. 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, attendance at scientific meetings and conferences, and through the Joint Service Research and Development (R&D) Technology Panel to the Office of the Secretary of Defense (OSD) Management Steering Committee for Embedded Computer Resources.

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H. (U) WORK PERFORMED BY: Computer Sciences Corporation, Moorestown, NJ; Control Data Corporation, Minneapolis, MN; Carnegie-Mellon University, Pittsburgh, PA; Charles Stark Draper Laboratories, Boston MA. Among the contracts to be awarded for FY80 will be the Ada Language System, (Defense Advanced Research Project Agency Network) ARPANET Security and Logistics Support Planning. In total, $2,866,184 in contracts will be awarded in FY80. In-house development is performed by the United States Army Communications Research and Development Command.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS: (From FY 1980 and prior, these programs are under Program Element 6.27.01A, Department of the Army Project 1L162701AH92B).

1. (U) FY 1979 and Prior Accomplishments: Military Computer Family (MCF) is an approach to effect standardization of the major hardware (computer, peripherals, and terminals) and software (language, operating systems, tools and products) components of battlefield automated systems. Released request for proposals for integrated logistic support and software planning standardization and control for the MCF. A computer language, Ada, was specified and a request for proposal for this language was released. Ada is a high order language to be used as a standard language in battlefield computers. The ARPANET Interface Processor was acquired for the Teleprocessing Design Center (TDC) which is required to connect remote tactical equipment to the TDC. An evaluation of the AN/TTC-39 Automatic Telephone Control Office software products was initiated in the TDC. Used the TDC to establish a baseline for TACFIRE and TOS2 interoperability, including integration of both military and commercial components. The development of a digital message miniterminal was begun as part of the product line for the Intelligent Terminal Family. A study on the tradeoffs among software, hardware, and firmware methodologies was begun. Developed and tested new applications and variations of intelligent terminals. Enhanced word recognition systems relative to man/machine methodologies. Videodisc players were evaluated as technology for information systems for training and maintenance with positive results. Participated with other services and NATO for computer resource management.

2. (U) FY 1980 Program: It is planned to initiate a contract for integrated logistic support and software planning for the Military Computer Family (MCF). An MCF training support contract is also to be awarded. Work is to be done on implementing the Ada language and to analyze the transition of on-going system developments to using Ada. In the Teleprocessing Design Center, which is used to support the MCF program, the capability to evaluate, validate, and enhance tactical automatic data processing system will be developed. A contract will be awarded to develop a digital message miniterminal as part of the product line for the intelligent terminal family. A methodology will be developed to evaluate microprocessor hardware, software, and firmware tradeoffs. A contract will be awarded to develop a life cycle structure for software development. Communicative technology work will be performed in support of both Job Training Packages (JTP's) and Skill Performance Aids delivery systems. Work will be initiated leading towards the development of an electronic on-line update and access system to

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be used for training and technical documentation. These efforts will include contractual awards for: Improved Video Disc Frame Access Time, Delivery System, Interactive Software Specifications, Strategies for Built-In Test of Electronic Delivery Systems, and On-Line Update and Access System Concept Study. These efforts address the technology issues essential to initiate system development.

3. (U) FY 1981 Planned Program: Exploratory development for MCF will be continued in the areas of integrated logistics support, built-in training, and software. Guidance, planning, and support will continue with respect to the development, verification, and validation of Ada. Since the Ada language is substantially different from other programming languages now in use (such as those on the DOD approved list), an effort will be initiated to develop an organized body of knowledge and techniques on how to make the most effective use of the state of the art language facilities present in Ada when designing embedded computer systems. A program begun in FY80 for concepts of how best to support battlefield automated systems over their life cycle, will be continued. As a minimum, these guidelines will include: standards for software tools, configuration management, and quick reaction capability for post deployment software support. The development of the Ada language system and other software support tools will require development of specific tools for maintenance purposes. To this end, an effort will be initiated to develop a prototype structured design diagrammer which will be used to maintain the software developed under other efforts. An effort will be initiated to develop a prototype implementation of a transportable real-time tactical executive (operating system) that will address the security, scheduling and resource allocation aspects of tactical computer based weapons systems and thereby avoid the necessity of developing (at great expense) a completely new operating system for each computer system. A Microprogrammable Multiprocessor (MMP) provides emulation capability in the Teleprocessing Design Center (TDC). The MMP will be enhanced and a contract will be awarded to install a secure interface capability between the MMP and tactical systems at other locations using the Defense Advanced Research Projects Agency Network (ARPANET) communications. This will allow passing classified software modules between separated development sites quickly for use or futher testing. In-house TDC efforts will encompass support activities relative to MCF system producibility, integration and validation. Tactical computer peripherals will be advanced by using distributed techniques, improving human interfaces and achieving compatability of interfaces. The exploratory development contract on a Digital Message Miniterminal to provide tactical forces interactive communications with any Army tactical data system will be continued. Work will also continue in improving policies, procedures, and standards for the management of computer resources. Automated testing will be furthered with the formalization of an automated tester prediction model that can be used to assist in the design of test equipment for future systems that contain new technology. In addition, testing equipment will be designed to support military-peculiar applications in Army tactical electronic counter measure equipment. In the area of communicative technology, work will be performed to understand appropriate ways in which information to be maintained in a locally accessed electronic archive should be recorded both for internal retention and network distribution. Army portion of Department of Defense's Computer Security Consortium funding will be coordinated and provided from this program element.

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4. (U) FY 1982 Planned Program: Continue product planning and control contractual work for the Military Computer Family (MCF) integrated logistics support, built-in training and software. Users, such as project managers, will be provided with software and documentation to enable them to utilize the Software Development Support Systems (SDSS) Facility and its software tools and to establish similar support facilities utilizing proven software. In the Teleprocessing Design Center, a quick-reaction support capability will be provided for validation and verification efforts related to tactical ADP system technology insertion and compatibility via the microprogrammable multiprocessor (MMP) testbed. Experiments will be conducted to validate Army distribution systems. Packet switching concepts will be implemented and intra-system communication efficiency will be verified. In addition, contractual support efforts in the areas of distributed terminal/peripheral system methodologies, microprocessor/microcomputer hardware/software/firmware tradeoff techniques for terminals/peripherals, as well as advanced techniques relative to extended man/machine interactive methodologies for enhancements of advanced terminal technology will be actively pursued. Emphasis will be placed on realistically evaluating the major benefits of distributed versus centralized processing, and the tradeoffs involved. It is planned to initiate a contractual effort to study and evaluate methodologies for achieving optimal design criteria relative to microprocessor-driven intelligent terminals and peripherals. A contract to develop improved CRM documents and synthesis of requirements anlaysis techniques will be continued. A multi-year development effort will be initiated to establish design techniques for an advanced, distributed-processing automatic test capability. Digital functions will be defined which can be implemented in testable or self-checked, very high speed integration circuits. The parametric data and design techniques required to assure testability of tactical systems utilizing embedded optical/IR devices will be developed. A major effort will be directed toward the elimination of the need for most special purpose and dedicated test equipments and to develop technology insertion techniques. The test, measurement, and diagnostic equipment being developed will afford more efficient and accurate means of detecting equipment defects and predicting catastrophic failures, thereby offsetting the shortage of skilled personnel. Design for testability, which includes built-in test, is essential to achieving supportable systems at affordable costs. The following efforts will be performed in support of the on-line electronic update and access system: (A) Continue an analysis of the impact of this system on a communications network. (B) Continue an effort to provide highspeed information access to an archive for multiple users requesting the same documents where only one copy of that document exists in the data base at the archive. (C) Design a logical access delivery system configuration at component and functional level user work station. The work stations are located in the field and are connected through the network to the archive via regional hosts, where appropriate. (D) Establish all interface specifications and protocols that will be adhered to for information and signals throughout a system by designers of the individual items and functional subsystems.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.70.A
Title: Military Disease Hazards Technology
DoD Mission Area: #522 - Environmental & Life Sciences (ED)
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	23161	17892	17229	20366	Continuing	Not Applicable
A870	Risk Assessment of Military Disease Hazards	5331	4054	3461	3566	Continuing	Not Applicable
A871	Prevention of Military Disease Hazards	17830	13838	13768	16800	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Historically, infectious diseases have caused the land combat commander more casualties than overt enemy activity. This program seeks to minimize these casualties. It is required to identify and develop the means to combat diseases of greatest military importance. Objectives of the program are to conduct studies of parasitic, bacterial, rickettsial, and viral diseases of military importance and to develop an effective medical defense against the use of biological weapons. Research efforts include investigations in epidemiology, control, prevention, treatment, and evaluation of disease impact on military operations and the pathogenesis of potential biological agents, rapid laboratory identification of agents, and prevention or treatment of biological agent casualties. Research studies encompass vaccine development which leads to production and stockpiling for mobilization or operational contingencies in worldwide deployment of military troops. Methods for laboratory investigations are explored, developed, improved, and standardized.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Research will concentrate on specific infectious diseases which have the greatest proven or potential impact on troops in training, mobilization, or combat operations. Efforts will concentrate on developing data on diseases, reservoirs, vectors, development of new or improved vaccines and drugs for treatment, or for prevention of infection. Specific diseases of military importance to be studied are malaria, leishmaniasis, schistosomiasis, diarrhea, trypanosomiasis (African sleeping sickness), scrub typhus, hepatitis, adeno- (upper respiratory) and arbovirus infections. New field and laboratory techniques for disease vector control will be developed and evaluated. This program is also the sole DoD effort in the national program for medical defense against the potential use of biological warfare (BW) agents. Developments are utilized in mobilization and operational contingency plans. Recent Congressional hearings have emphasized the need for a strong BW defense. NATO working groups maintain cognizance of BW defense research results. The Departments of Health, Education, and Welfare; Agriculture; and the Center for Disease Control maintain an active interest in vaccine production efforts, especially in the realm of unique or exotic agents. 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 is required to improve predevelopment immunization capabilities against most likely agents.

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D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	23161	17892	17229	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	22956	19135*	20068*	Continuing	Not Applicable

This is a restructured program element which is a consolidation of work previously performed under this program element, Program Element 6.27.76.A, Medical Defense Against BW Agents, and Program Element/Project 6.27.72.A/A810, Military Skin Diseases. Consolidation of program elements will permit integration of related research capabilities to better support highest priority tasks with minimum funds and manpower.

*Funds shown in FY 1980 RDTE Congressional Descriptive Summaries submission under Program Elements 6.27.70.A and 6.27.76.A for FY 1980 were $12212 and $6923, respectively; FY 1981 estimates for these Program Elements as shown in FY 1980 submission were $11854 and $8214, respectively. The increase in FY 1979 represents transfer of funds for increased costs at LAIR associated with a personnel reduction and for essential contracts in infectious disease research. Decrease in FY 1980 current requirements was directed by Congress. The reduction in the FY 1981 estimate reflects decreased emphasis in Project A870 for epidemiological assessment of agents associated with military disease hazards, and a budgetary decision to defer exploratory development under Project A871 of drugs and vaccines until FY 1982.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.70.A
Title: Military Disease Hazards Technology
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Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program is designed to develop and enhance technology for assessment, diagnosis, prevention and treatment of infectious disease to minimize impact on training and mobilization of military operations worldwide. Epidemic and geographically unique endemic infectious diseases are a major constraint upon military strategic mobility. It includes studies required to investigate parasitic, bacterial, rickettsial, and viral diseases. Epidemiologic data provide information on the transmission, ecology, control, vectors, and reservoirs of militarily significant infectious disease. A major effort is devoted to development of improved methods for preventing, curing, and eradicating parasites as a menace to deployed military forces. This program is also designed to develop an effective medical defense against known and potential biological weapons. Data are utilized to formulate a total medical approach for prevention and treatment of biological warfare (BW) casualties. Program derives from militarily unique impact of specific diseases which are not of general concern to the US civilian medical community. It forms the technological basis for formulation, advanced development, production, and testing of drugs, vaccines, and other biological means of protection against militarily important infectious diseases. Program develops therapeutic agents against diseases affecting strategic mobility for which there is no domestic market. This program is the only national resource for vaccine development specifically for armed services. Investigations in aerosol immunization and protection systems against BW and other hazardous infectious diseases are a significant component of this program.

G. (U) RELATED ACTIVITIES: Related Army studies are performed under Program Element 6.11.02.A, Project BS10, Research on Military Diseases, Injury and Health Hazards; and Program Element 6.37.50.A, Drug and Vaccine Development. Complementary infectious disease research is conducted by the Navy, National Institutes of Health, Department of Agriculture, and the Center for Disease Control. Army research does not duplicate these efforts as the unique aspects of land combat operations dictate an Army program which focuses on optimal support of military ground operations and learning to recognize, prevent, and treat infectious diseases which cause more lost duty time than combat wounds. This program element is also the sole DoD input in the national program for medical defense against biological agents. Army representation on Department of Defense coordinating committee and other intergovernmental agency coordination councils insures coordination at the working and administrative levels in order to prevent duplication of effort. Army scientists serve as consultants with the World Health Organization and have access to this organization's studies, reports, and publications. Other coordination is accomplished by personal contacts at the operating level, by site visits by project officers, organization of technical 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 resumes.

H. (U) WORK PERFORMED BY: Approximately 73% of the research is performed by in-house laboratories at Walter Reed Army Institute of Research, Washington, DC, and field units in Thailand, Malaysia, Brazil, and Kenya; by the US Army Medical Research Institute of Infectious Diseases, Fort Detrick, Frederick, MD; the US Army Institute of Dental Research, Washington, DC; and the Letterman Army Institute of Research, Presidio of San Francisco, CA. Approximately 27% of the research is conducted under contract with universities, nonprofit organizations, and industry. The five major contracts are those with Herner and Co., Bethesda, MD; Midwest Research Institute, Kansas City, MO; University of Miami, Miami, FL; Parke Davis & Co., Ann Arbor, MI; and Columbia University, New York, NY. Fifty-four other contractors are funded in the amount of $3,255,000.

Program Element: #6.27.70.A
DoD Mission Area: #522 - Environmental & Life Sciences (ED)

Title: Military Di e Hazards Technology
Budget Activity: #1 - Technology Base

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Have successfully performed research in assessment technology to include: recently described the epidemiology and ecology of several viral infections of military importance; defined Oropouche disease incriminated during an epidemic in Brazil; completed studies of other infectious diseases in the Brazil Transamazon region, and identified potential disease risks; utilized a new radioimmunoassay technique to determine incidence and effects of hepatitis on soldiers of the 25th Infantry Division; completed epidemiological investigation of leishmaniasis among troops undergoing jungle training in Panama; completed a manual for identification of new world insect vectors of leishmaniasis for use by disease control teams; and published a catalog of world mosquitoes which provides data necessary for advanced studies on mosquito-borne diseases. Conducted studies in development of improved diagnostic capabilities: developed an assay procedure for the Korean hemorrhagic fever agent; developed a new technique using DNA homology for rapidly identifying newly isolated microorganisms against a wide spectrum of disease producing microorganisms; developed or modified new serological techniques including radioimmunoassay, chemiluminescence and enzyme linked immunosorbant assay (ELISA) for use in detecting BW infections; perfected an ELISA technique that will lead to rapid diagnosis of leishmaniasis in man; refined a sensitive and specific radioimmunoassay technique for detection of hepatitis A virus and antibody; developed an effective procedure for serotyping Group A meningococci, providing a tool for epidemiological surveillance of disease in troops. Exploited recent technological advances in pathophysiology: established a laboratory colony of host snails for rearing large numbers of Schistosoma cercariae; this significant breakthrough provided sufficient test animals for screening antischistosomal prophylactic drugs; identified animal models for diagnosis and study of Tacaribe and Machupo viruses, disease agents of potential BW importance. Maintained research expertise in drug development: utilized the antimalarial system to initiate an integrated antiparasitic drug program providing accelerated drug development and human testing for the DoD; in FY 1979, screened 500 compounds for activity against Leishmania, 4000 for activity against Trypanosoma (African sleeping sickness), 2000 for activity against Schistosoma, and 5000 for activity against Plasmodium (malaria); chemotherapy of leishmaniasis was shown to be markedly enhanced in animal models through the use of liposome drug carriers; demonstrated that a new drug, WR 6026 (lepidine), was 500 times more effective in its activity against leishmaniasis than drugs currently used to treat the disease; established selective screening program to evaluate drugs in several chemical classes of prophylactic activity against schistosomiasis, a disease second only to malaria in causing morbidity and mortality in tropical and subtropical regions; identified a compound that will effectively prevent penetration of skin by the infective stage of Schistosoma; Mefloquine, an effective antimalarial drug, was identified and developed by the USAMRDC; identified a compound that will protect mice against experimentally induced trypanosomiasis (African sleeping sickness) for seven months following the administration of a single dose of this drug; ribavirin, an antiviral drug, was found effective for treatment of Bolivian hemorrhagic fever in animal models. Enhanced capabilities in repellent development: established and maintained colonies of laboratory arthropods for repellent testing; evaluated candidate topical repellents on animals and in vitro; four candidate chemical compounds were evaluated for their efficacy as repellents against the vector of leishmaniasis. Emphasized program in improvement of development of new vaccines for military use: completed development and initial production of meningococcal polysaccharide vaccine for types A and C diseases; immunity to viral infections has been enhanced by using a metabolizable lipid adjuvant; a gamma-irradiated trypanosome (African sleeping sickness) vaccine was

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evaluated in animals under both laboratory and field conditions; immunity was conferred for 14 months; Gonococcal, Pseudomonas and Escherichia pilus vaccines were tested in experimentally infected animals and shown to be safe and effective; a strain of Shigella has been constructed by genetic techniques which produced antigens capable of protecting animals against 80% of Shigella strains in US; technology derived from dengue type 2 vaccine development was used in initiation of vaccine studies for other dengue serotypes; variant of Junin virus (Argentine hemorrhagic fever) was discovered which has potential as a vaccine candidate for Argentine (AHF) and Bolivian hemorrhagic fevers (BHF); prepared an attenuated Chikungunya virus vaccine in tissue culture; studies on the production and characterization of bacterial exotoxins from bacteria of military disease importance essential to the development of diagnostic procedures, have been initiated.

2. (U) FY 1980 Program: Continue the epidemiological studies of arboviruses and their vectors which affect military operations in temperate and tropical regions. Monitor and study the epidemiology of dengue 1 disease in the Carribean region and the Rift Valley fever in the Middle East. Examine the biological properties of Ebola/Marburg viruses in vitro and in laboratory animal models to assess their potential as BW threats. Determine the impact of hepatitis A, B and non A-non B on US military personnel in Europe, Korea and US garrisons. Determine the etiology of acute respiratory disease (ARD) in recruit training centers where significant ARD has occurred in spite of adenovirus and influenza vaccination. Evaluate the magnitude and potential impact of drug resistant parasites, notably visceral leishmaniasis in Kenya and cutaneous leishmaniasis among US troops training in Panama. Monitor the continued spread of drug resistant malaria in strategically relevant areas of the world (Asia, Africa, and the Americas), and evaluate the extent of drug resistance in Brazil. Prepare and publish identification manuals of malaria vectors of Central and South American tropics for use by field vector control teams. Develop, refine and evaluate improved rapid diagnostic procedures for arboviruses and other highly hazardous potential BW agents. Conduct advanced investigations concerning infection mechanisms, host organ localization, cellular penetration, and aerosol susceptibility to a variety of potential BW microorganisms. Continue to determine factors which contribute to host resistance to microbial infections. Screen selected classes of compounds for antimicrobial activity, and examine the mode of action of candidate prophylactic and therapeutic drugs. Evaluate drugs for activity against parasitic diseases causing soldier ineffectiveness or death, and initiate preclinical testing of antiparasitic drugs. Synthesize antimalarial drugs from alternative classes which would protect against Mefloquine resistant malaria; complete synthesis of alternatives to primaquine. Initiate preclinical assessment of alternatives to standardized drugs for leishmaniasis, and suppressive prophylactic drugs for African trypanosomiasis (sleeping sickness). Continue development of the new liposome drug delivery system for treatment of leishmaniasis. Expand knowledge of antiviral drug therapy in animal models. Test the efficacy of antiviral agents in controlling Ebola virus infections. Continue to develop, standardize and perform laboratory and field efficacy tests for candidate topical repellents and formulation additives. Determine optimum methods for use of area repellents. Test gamma-irradiated African trypanosomiasis (sleeping sickness) vaccine for efficacy and safety in primates and collect data required for evaluation in humans. Continue advanced studies of pilus vaccines for protection against militarily-relevant bacterial diseases. Continue efficacy study of hybrid Shigella bacteria vaccine in animals. Examine alternative routes of administration of dengue 2 vaccine in primates. Initiate animal testing of candidate vaccines for dengue virus types 1, 3 and 4. Evaluate the Junin virus variant as a candidate vaccine for AHF and BHF. Evaluate the efficacy of an attenuated Chikungunya virus vaccine in animals.

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Evaluate cross protection accorded Bunya virus infections by Rift Valley fever virus vaccine. Initiate animal testing of a candidate vaccine against Ebola virus, a newly described agent from Africa producing severe febrile illness in man. Further characterize the etiologic agent of Korean hemorrhagic fever (KHF) virus to determine the feasibility of preparing an effective vaccine. Apply available technology to preparation of an inactivated Lassa fever virus vaccine. Evaluate the potential for preparing a vaccine against Legionnaires' bacteria. Adapt Rickettsia tsutsugamushi (scrub typhus) to grow in cell substrates acceptable for human vaccine production. Expand bacterial toxin exploratory development and technology base for protection against incapacitating effects of microbial toxins.

3. (U) FY 1981 Planned Program: Continue to define the epidemiology of pathogens causing tropical diseases in strategic geographical regions so that more effective control procedures can be initiated. Continue to broaden the data base on incidence and prevalence of hazardous viruses and potential BW agents and the factors that influence them. Monitor the incidence of hepatitis and respiratory diseases in military personnel. Assess other microbial disease risks to soldiers conducting field operations in endemic areas for inclusion into contingency planning scenarios. Continue to monitor the spread of drug resistant parasites (viz: malaria, leishmaniasis). Increase the capability of arbovirus reference centers to rapidly identify viral diseases and their vectors and to provide standardized reference reagents for Army field teams. Establish and equip mobile teams capable of evaluating and diagnosing potential or suspected BW incidents. Evaluate the transportability of patients and laboratory specimens under total containment conditions. Expand knowledge of the vector-pathogen-host relationship for endemic, epidemic and potential BW diseases and utilize data for understanding host pathogenesis, susceptibility and resistance in addition to developing disease control measures. Continue preclinical testing of antiparasitic drugs. Emphasis placed on drugs for Mefloquine-resistant malaria and alternative drugs for prevention or treatment of leishmaniasis and African sleeping sickness. Apply liposome drug delivery system technology or parasitic diseases other than leishmaniasis. Screen selected classes of compounds for broad antimicrobial activity and examine the mode of action of candidate prophylactic or therapeutic drugs. Advances in molecular virology indicate feasibility of developing effective drugs for prevention or treatment of incapacitating virus diseases. Studies will be initiated on formulation, leading to fielding, of effective antiviral compounds urgently needed to prevent or treat military relevant viral diseases which might lead to total operational mission failure, jeopardize readiness and strategic mobility, or impede mobilization or training. Coordinate toxicologic evaluation of topical and area repellents. Rank area repellents on basis of efficacy and persistence and determine impact of their use. Complete animal efficacy studies of gamma-irradiated African sleeping sickness vaccine and hybrid Shigella bacterial vaccine. Continue animal studies with pilus vaccines. Continue vaccine development for dengue virus types 1, 3 and 4. Complete evaluation of Junin virus variant as candidate vaccine. Continue efficacy testing of Chikungunya virus vaccine in animals. Further characterize cross protection of Rift Valley fever virus and other related viruses. Continue animal efficacy studies of candidate Ebola virus vaccine. Initiate testing of KHF vaccines in animals. Test an inactivated Lassa fever vaccine in animals. Continue development of a vaccine against Legionnaires' disease. Characterize growth kinetics of rickettsial organisms in cell culture to optimize yield for vaccine production. Prepare candidate anthrax bacterial vaccines. Standardize immune serum globulin for hepatitis A virus. Toxin-producing organisms pose a major threat to US forces. Definitive research will be performed to more rapidly assess and develop appropriate improved antitoxins and vaccines to protect exposed military personnel. Personnel to be utilized: 319 professional, and 412 support.

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4. (U) FY 1982 Planned Program: Assess potential viral, bacterial, rickettsial and parasitic disease threats to military personnel and compile epidemiological data necessary for development, prevention and control measures. Expand data bases on exotic military disease hazards and potential BW weapons employment to insure inclusion in combat scenarios and contingency plans. Provide new or improved techniques for risk evaluation and epidemiology of diseases affecting troop mobilization, deployment and operations. Field test laboratory microbiological capabilities using state-of-the-art procedures for the diagnosis of disease caused by diverse organisms and toxins. Expand studies on factors contributing to the broad range of host responses to infections. Screen selected doses of compounds for antimicrobial activity and examine the mode of action of candidate prophylactic and therapeutic drugs. Continue antiparasitic drug development with emphasis on malaria, leishmaniasis, schistosomiasis and sleeping sickness. Evaluate utility of liposome drug delivery systems in parasitic diseases. Refine program leading to the development of a series of drug products effective against viruses of military concern. Select most promising topical and area repellents for final animal efficacy and toxicological testing. Continue animal efficacy studies of pilus vaccines. Complete developmental phase for dengue virus serotypes 1, 3 and 4 vaccines. Conclude cross-protection studies with Rift Valley fever virus vaccines. Continue laboratory evaluations of Ebola, Chikungunya, Lassa fever, Korean hemorrhagic fever and anthrax vaccines to assess safety and effectiveness. Perform safety and efficacy of Legionnaires' disease vaccine product. Produce small pilot lots f gamma-irradiated scrub typhus vaccines for test in laboratory animals. Initiate development of vaccines against highly virulent viruses (Marburg, Congo-Crimean) which may be encountered naturally or might be employed in BW environments. Assess and upgrade programmatic approach to protection from effects of toxin producing organisms.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A871 Title: Prevention of Military Disease Hazards
Program Element: #6.27.70.A Title: Military Disease Hazards Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This program is designed to develop and enhance technology for diagnosis, prevention and treatment of infectious disease to minimize impact on training and mobilization of military operations worldwide. Epidemic and geographically unique endemic infectious diseases are a major constraint upon military strategic mobility. Includes studies required to investigate parasitic, bacterial, rickettsial, and viral diseases. A major effort is devoted to development of improved methods for preventing, curing, and eradicating parasites as a menace to deployed military forces. This program is also designed to develop an effective medical defense against known and potential biological weapons. Data are utilized to formulate a total medical approach for prevention and treatment of biological warfare (BW) casualties. Program derives from militarily unique impact of specific diseases which are not of general concern to the United States civilian medical community. Forms the technological basis for formulation, advanced development, production, and testing of drugs, vaccines, and other biological means of protection against militarily important infectious diseases. Program develops therapeutic agents against diseases affecting strategic mobility for which there is no domestic market. This program is the only national resource for vaccine development specifically for armed services. Investigations in aerosol immunization and protection systems against BW and other hazardous infectious diseases are a significant component of this program.

B. (U) RELATED ACTIVITIES: Related Army studies are performed under Program Element 6.11.02.A, Defense Research Sciences; Program Element 6.27.70.A, Military Disease Hazards Technology; Project A870, Disease Risk Assessment to Troop Operations and Mobilization; and Program Element 6.37.50.A, Drug and Vaccine Development. Complementary infectious disease research is conducted by the Navy, National Institutes of Health, Department of Agriculture, and the Center for Disease Control. Army research does not duplicate these efforts. The unique aspects of land combat operations dictate an Army program which focuses on optimal support of military operations and learning to recognize, prevent, and treat infectious diseases which cause more lost duty time than combat wounds. This program is the sole DOD input in the national program for medical defense against biological agents. Army representation on Department of Defense coordinating committee and other intergovernmental agency coordination councils insures coordination at the working and administrative levels in order to prevent duplication of effort. Army scientists serve as consultants with the World Health Organization and have access to this organization's studies, reports, and publications. Other coordination is accomplished by personal contacts at the operating level, by site visits by project officers, organization of technical 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 resumes.

Project: #A871 Title: Prevention of Military Disease Hazards
Program Element: #6.27.70.A Title: Military Disease Hazards Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

C. (U) WORK PERFORMED BY: Approximately 76% of the research is performed by in-house laboratories at Walter Reed Army Institute of Research, Washington, DC, and field units in Thailand, Malaysia, Brazil, and Kenya; by the US Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD; the US Army Institute of Dental Research, Washington, DC; and the Letterman Army Institute of Research, Presidio of San Francisco, CA. Approximately 24% of the research is conducted under contract with universities, nonprofit organizations, and industry. The five major contracts are those with Llerner and Co., Bethesda, MD; Midwest Research Institute, Kansas City, MO; Parke Davis & Co., Ann Arbor, MI; University of Miami, Miami, FL; Columbia University, New York, NY. Fifty-four other contractors are funded in the amount of $3,255,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Conducted studies in development of improved diagnostic capabilities; an in vitro assay procedure was developed for the Korean hemorrhagic fever virus agent; a new technique using DNA homology has been developed for rapidly identifying newly isolated microorganisms against a wide spectrum of disease producing microorganisms; new serological techniques including radioimmunoassay, chemiluminescence and enzyme linked immunosorbant assay (ELISA) have been developed or modified for use in detecting BW infections; an ELISA technique has been perfected that will lead to a rapid diagnosis of leishmaniasis in man; a sensitive and specific radioimmunoassay technique was perfected for detection of hepatitis A virus and antibody; an effective procedure was developed for serotyping Group A meningococci, providing a tool for epidemiological surveillance of disease in troops. Exploited recent technological advances in pathophysiology: a laboratory colony of host snails for rearing large numbers of Schistosoma cercariae was developed; this significant breakthrough provided sufficient test animals for screening antischistosomal prophylactic drugs; animal models for diagnosis and study of Tacaribe and Machupo viruses, disease agents of potential BW importance, have been developed. Maintained research expertise in drug development: utilizing the antimalarial system, initiated an integrated antiparasitic drug program providing for accelerated drug development and human testing for the DOD; in FY 1979, screened 500 compounds for activity against Leishmania, 4000 for activity against Trypanosoma (African sleeping sickness), 2000 for activity against Schistosoma, and 5000 for activity against Plasmodium (malaria); chemotherapy of leishmaniasis was shown to be markedly enhanced in animal models through the use of liposome drug carriers; demonstrated that a new drug, WR 6026 (lepidine), was 500 times more effective in its activity against leishmaniasis than drugs currently used to treat the disease; established selective screening program to evaluate drugs in several chemical classes of prophylactic activity against schistosomiasis, a disease second only to malaria in causing morbidity and mortality in tropical and subtropical regions; identified a compound that will effectively prevent penetration of skin by the infective stage of Schistosoma; Mefloquine, an effective antimalarial drug, was identified and developed by the USAMRDC; identified a compound that will protect mice against experimentally induced trypanosomiasis for seven months following the administration of a single dose of this drug; Ribavirin, an

Project: #A871 Title: Prevention of Military Disease Hazards
Program Element: #6.27.70.A Title: Military Disease Hazards Technology
DOD Mission Area: #522 - Environmental and Life Scienc s (ED) Budget Activity: #1 - Technology Base

antiviral drug, was found effective for treatment of Bolivian hemorrhagic fever in animal models. Enhanced capabilities in repellent development: established and maintained colonies of laboratory arthropods for repellent testing; evaluated candidate topical repellents on animals and in vitro; four candidate chemical compounds were evaluated for their efficacy as repellents against the vector of leishmaniasis. Emphasized program in improvement of development of new vaccines for military use: completed development and initial production of bacterial meningococcal polysaccharide vaccine for types A and C diseases; immunity to viral infections has been enhanced by using a metabolizable lipid adjuvant; a gama-irradiated trypanosome (African sleeping sickness) vaccine was evaluated in animals under both laboratory and field conditions; immunity was conferred for 14 months; Gonococcal, Pseudomonas and Escherichia pilus bacteria vaccines were tested in experimentally infected animals and shown to be safe and effective; a strain of Shigella bacteria has been constructed by genetic techniques which produced antigens capable of protecting animals against 80% of bacterial Shigella strains in US; technology derived from dengue type 2 vaccine development was used in initiation of vaccine studies for other dengue serotypes; variant of Junin virus (Argentine hemorrhagic fever) was discovered which has potential as a vaccine candidate for Argentine (AHF) and Bolivian hemorrhagic fevers (BHF); prepared an attenuated Chikungunya virus vaccine in tissue culture; studies on the production and characterization of bacterial exotoxins from bacteria of military importance essential to the development of diagnostic procedures, have been initiated.

2. (U) FY 1980 Program: Develop, refine and evaluate improved rapid diagnostic procedures for arboviruses and other highly hazardous potential BW agents. Conduct advanced investigations concerning infection mechanisms, host organ localization, cellular penetration, and aerosol susceptibility to a variety of potential BW microorganisms. Continue to determine factors which contribute to host resistance to microbial infections. Screen selected classes of compounds for antimicrobial activity, and examine the mode of action of candidate prophylactic and therapeutic drugs. Evaluate drugs for activity against parasitic diseases causing soldier ineffectiveness or death, and initiate preclinical testing of antiparasitic drugs. Synthesize antimalarial drugs from alternative classes which would protect against Mefloquine resistant malaria; complete synthesis of alternatives to primaquine. Initiate preclinical assessment of alternatives to standardized drugs for leishmaniasis, and suppressive prophylactic drugs for African sleeping sickness. Continue development of the new liposome drug delivery system for treatment of leishmaniasis. Expand knowledge of antiviral drug therapy in animal models. Test in vitro and in vivo the efficacy of antiviral agents in controlling Ebola virus infections. Continue to develop, standardize and perform laboratory and field efficacy tests for candidate topical repellents and formulation additives. Determine optimum methods for use of area repellents. Test gamma-irradiated African sleeping sickness vaccine for efficacy and safety in primates and collect data required for evaluation in humans. Continue advanced studies of pilus vaccines for protection against militarily-relevant bacterial diseases. Continue efficacy study of hybrid bacterial Shigella vaccine in animals. Examine alternative routes of administration of dengue 2 virus vaccine in primates. Initiate animal testing of candidate vaccines for dengue virus types 1, 3 and 4. Evaluate the Junin virus

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variant as a candidate vaccine for AHF and BHF. Evaluate the efficacy of an attenuated Chikungunya virus vaccine in animals. Evaluate cross protection accorded Bunya virus infections by Rift Valley fever virus vaccine. Initiate animal testing of a candidate vaccine against Ebola virus, a newly described agent from Africa producing severe febrile illness in man. Further charactreize the etiologic agent of Korean hemorrhagic fever (KHF) virus to determine the feasibility of preparing an effective vaccine. Apply available technology to preparation of an inactivated Lassa fever virus vaccine. Evaluate the potential for preparing a vaccine against Legionnaires' bacteria. Adapt Rickettsia tsutsugamushi (scrub typhus) to grow in cell substrates acceptable for human vaccine production. Expand bacterial toxin exploratory development and technology base for protection against incapacitating effects of microbial toxins.

3. (U) FY 1981 Planned Program: Increase the capability of arbovirus reference centers to rapidly identify viral diseases and their vectors and to provide standarized reference reagents for Army field teams. Establish and equip mobile teams capable of evaluating and diagnosing potential or suspected BW incidents. Evaluate the transportability of patients and laboratory specimens under total containment conditions. Expand knowledge of the vector-pathogen-host relationship for endemic, epidemic and potential BW diseases and utilize data for understanding host pathogenesis, susceptibility and resistance in addition to developing disease control measures. Continue preclinical testing of antiparasitic drugs. Emphasis placed on drugs for Mefloquine-resistant malaria and alternative drugs for prevention or treatment of leishmaniasis and African trypanosomiasis (sleeping sickness). Apply liposome drug delivery system technology to parasitic diseases other than leishmaniasis. Screen selected classes of compounds for broad antimicrobial activity and examine the mode of action of candidate prophylactic or therapeutic drugs. Advances in molecular virology indicate feasibility of developing effective drugs for prevention or treatment of incapacitating virus diseases. Studies will be initiated on formulation, leading to fielding of effective antiviral compounds urgently needed to prevent or treat military relevant viral diseases which might lead to total operational mission failure, jeopardize readiness and strategic mobility, or impede mobilization or training. Coordinate toxicologic evaluation of topical and area repellents. Rank area repellents on basis of efficacy and persistence and determine impact of their use. Complete animal efficacy studies of gamma-irradiated African sleeping sickness vaccine and hybrid bacterial Shigella vaccine. Continue animal studies with bacterial pilus vaccines. Continue vaccine development for dengue virus types 1, 3 and 4. Complete evaluation of Junin virus variant as candidate vaccine. Continue efficacy testing of Chikungunya virus vaccine in animals. Further characterize cross protection of Rift Valley fever virus and other related viruses. Continue aniaml efficacy studies of candidate Ebola virus vaccine. Initiate testing of KHF virus vaccines in animals. Test an inactivated Lassa fever virus vaccine in animals. Continue development of a vaccine against Legionnaires' disease. Characterize growth kinetics of rickettsial organisms in cell culture to optimize yield for vaccine production. Prepare candidate anthrax bacterial vaccines. Standardize immune serum globulin for hepatitis A virus. Toxin producing organisms pose a major threat to US forces. Definitive research will be performed to more rapidly assess and develop appropriate improved antitoxins and vaccines to protect exposed military personnel. Personnel to be utilized: 229 professional and 295 support.

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4. (U) FY 1982 Planned Program: Field test laboratory microbiological capabilities using state-of-the-art procedures for the diagnosis of disease caused by diverse organisms and toxins. Expand studies on factors contributing to the broad range of host responses to infections. Screen selected doses of compounds for antimicrobial activity and examine the mode of action of candidate prophylactic and therapeutic drugs. Continue antiparasitic drug development with emphasis on malaria, leishmaniasis, schistosomiasis and African sleeping sickness. Evaluate utility of liposome drug delivery systems in parasitic diseases. Refine program leading to the development of a series of drug products effective against viruses of military concern. Select most promising topical and area repellents for final animal efficacy and toxicological testing. Continue animal efficacy studies of bacterial pilus vaccines. Complete developmental phase for dengue virus serotypes 1, 3 and 4 vaccines. Conclude cross-protection studies with Rift Valley fever vaccines. Continue laboratory evaluations of Ebola, Chikungunya, Lassa fever, Korean hemorrhagic fever and anthrax vaccines to assess safety and effectiveness. Perform safety and efficacy of Legionnaires' disease vaccine product. Produce small pilot lost of gamma-irradiated scrub typhus vaccines for test in laboratory animals. Initiate development of vaccines against highly virulent viruses (Marburg, Congo-Crimean) which may be encountered naturally or might be employed in BW environments. Assess and upgrade programmatic approach to protection from effects of toxin producing organisms.

5. (U) Program to Completion: This is a continuing program.

6. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	17830	13838	13768	16800	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	17625	13846*	14597*	-	Continuing	Not Applicable

This new FY 1981 Project is a consolidation of research previously performed under Program Element/Project 6.27.70.A/A803 and A802 (in part) as well as part of Program Element/Project 6.27.76.A/A841, Medical Defense Against BW Agents, and Program Element/Project 6.27.72.A/A810, Military Skin Disease. The remainder of work previously supported under Projects A802 and A841 are supported under Program Element/Project 6.27.70.A/A870.

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*Funds shown on FY 1980 submission under Projects A802, A803, and Program Element/Project 6.27.76.A/A841 for FY 1980 were $5021, $4000 and $4825, respectively. FY 1981 estimates for these efforts as shown on FY 1980 submission were $4680, $4200 and $5717, respectively. The increase in FY 1979 represents transfer of funds for increased costs at LAIR associated with a personnel reduction and for essential contracts in infectious disease research. The FY 1980 reduction in current requirements resulted from an equivalent reduction in Program Element 6.27.70.A directed by Congress. The FY 1981 decrease from last year's estimat results from budgetary decisions which will defer exploratory development of selected drugs and vaccines until FY 1982.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical Area: #01

Title: Prevention of Disease Affecting Troop Operation and Mobilization

Project: #A871

Title: Prevention of Military Disease Hazards

Program Element: #6.27.70.A

Title: Military Disease Hazards Technology

DoD Mission Area: #522 - Environmental and Life Sciences (ED)

Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This technical area is designed to develop and enhance technology for diagnosis, prevention and treatment of infectious disease to minimize impact on training and mobilization of military operations worldwide. Epidemic and geographically unique endemic infectious diseases are a major constraint upon military strategic mobility. Includes studies required to investigate parasitic, bacterial, rickettsial, and viral diseases. A major effort is devoted to development of improved methods for preventing, curing, and eradicating parasites as a menace to deployed military forces. Program derives from militarily unique impact of specific diseases which are not of general concern to the US civilian medical community. Forms the technological basis for formulation, advanced development, production, and testing of drugs, vaccines and other biological means of protection against militarily important infectious diseases. Program develops therapeutic agents against diseases affecting strategic mobility for which there is no domestic market. The unique aspects of land combat operations dictate an Army program which focuses on optimal support of military operations and learning to recognize, prevent, and treat infectious diseases which cause more lost duty-time than combat wounds. This program is the only national resource for drug and vaccine development specifically for the armed services.

B. (U) RELATED ACTIVITIES: Related Army studies are performed under Program Element 6.11.02.A, Defense Research Sciences; 6.27.70.A, Military Disease Hazards Technology, Project A870, Risk Assessment of Military Disease Hazards; and Program Element 6.37.50.A, Drug and Vaccine Development. Complementary infectious disease research is conducted by the Navy, National Institutes of Health, Department of Agriculture, and the Center for Disease Control. Army research does not duplicate these efforts. Army representation on Department of Defense coordinating committee and other intergovernmental agency coordination councils insures coordination at the working and administrative levels in order to prevent duplication of effort. Army scientists serve as consultants with the World Health Organization and have access to this organization's studies, reports, and publications. Other coordination is accomplished by personal contacts at the operating level, by site visits by project officers, organization of technical 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 resumes.

C. (U) WORK PERFORMED BY: Approximately 67% of the research is performed by in-house laboratories at Walter Reed Army Institute of Research, Washington, DC, and field units in Thailand, Malaysia, Brazil, and Kenya; US Army Institute of Dental Research, Washington, DC; and the Letterman Army Institute of Research, Presidio of San Francisco, CA. Approximately 33% of the research is conducted under contract with universities, non-profit organizations and industry. The five major contracts are those with

Technical Area: #01

Project: #A871
Program Element: #6.27.70.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Prevention of Disease Affecting Troop Operation and Mobilization
Title: Prevention of Military Disease Hazards
Title: Military Disease Hazards Technology
Budget Activity: #1 - Technology Base

Herner and Co., Bethesda, MD; Midwest Research Institute, Kansas City, MO; Parke Davis and Co., Ann Arbor, MI; University of Miami, Miami, FL; Columbia University, New York, NY. Fifty other contractors are funded in the amount of $2,856,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Conducted studies in development of improved diagnostic capabilities: developed a new technique using DNA homology for rapidly identifying newly isolated microorganisms against a wide spectrum of disease producing microorganisms; perfected an ELISA technique that will lead to a rapid diagnosis of leishmaniasis in man; established a sensitive and specific radioimmunoassay technique for detection of hepatitis A virus and antibody; developed an effective procedure for serotyping Group A meningococci, providing a tool for epidemiological surveillance of disease in troops. Exploited recent technological advances in pathophysiology: established a laboratory colony of host snails for rearing large numbers of Schistosoma cercariae; this significant breakthrough provided sufficient test animals for screening antischistosomal prophylactic drugs. Maintained research expertise in drug development: utilized the antimalarial system to initiate an integrated anti-parasitic drug program providing for accelerated drug development and human testing for the DoD; in FY 1979, screened 500 compounds for activity against Leishmania, 4000 for activity against Trypanosoma (African sleeping sickness), 2000 for activity against Schistosoma, and 5000 for activity against Plasmodium (malaria); chemotherapy of leishmaniasis was shown to be markedly enhanced in animal models through the use of liposome drug carriers; demonstrated that a new drug, WR 6026 (lepidine), was 500 times more effective in its activity against leishmaniasis than drugs currently used to treat the disease; established selective screening program to evaluate drugs in several chemical classes of prophylactic activity against schistosomiasis, a disease second only to malaria in causing morbidity and mortality in tropical and subtropical regions; identified a compound that will effectively prevent penetration of skin by the infective stage of Schistosoma; Mefloquine, an effective antimalarial drug, was identified and developed by the USAMRDC; identified a compound that will protect mice against experimentally induced trypanosomiasis for seven months following the administration of a single dose of this drug. Enhanced capabilities in repellent development: established and maintained colonies of laboratory arthropods for repellent testing; evaluated candidate topical repellents on animals and in vitro; four candidate chemical compounds were evaluated for their efficacy as repellents against the vector of leishmaniasis. Emphasized program in improvement of development of new vaccines for military use: completed development and initial production of meningococcal polysaccharide vaccine for types A and C diseases; a gamma-irradiated trypanosome vaccine was evaluated in animals under both laboratory and field conditions; immunity was conferred for 15 months;

Technical Area: #01 Title: Prevention of Disease Affecting Troop Operation and Mobilization

Project: #A871 Title: Prevention of Military Disease Hazards

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

DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

Gonococcal, Pseudomonas and Escherichia bacterial pilus vaccines were tested in experimentally infected animals and shown to be safe and effective; a strain of Shigella bacteria has been constructed by genetic techniques which produced antigens capable of protecting animals against 80% of Shigella strains in US; technology derived from dengue type 2 virus vaccine development was used in initiation of vaccine studies for other dengue serotypes.

2. (U) FY 1980 Program: Continue to determine factors which contribute to host resistance to microbial infections. Screen selected classes of compounds for antimicrobial activity, and examine the mode of action of candidate prophylactic and therapeutic drugs. Evaluate drugs for activity against parasitic diseases causing soldier ineffectiveness or death, and initiate preclinical testing of antiparasitic drugs. Synthesize antimalarial drugs from alternative classes which would protect against Mefloquine resistant malaria; complete synthesis of alternatives to primaquine. Initiate preclinical assessment of alternatives to standardized drugs for leishmaniasis, and suppressive prophylactic drugs for African sleeping sickness. Continue development of the new liposome drug delivery system for treatment of leishmaniasis. Continue to develop, standardize and perform laboratory and field efficacy tests for candidate topical repellents and formulation additives. Determine optimum methods for use of area repellents. Test gamma-irradiated African sleeping sickness vaccine for efficacy and safety in primates and collect data required for evaluation in humans. Continue advanced studies of bacterial pilus vaccines for protection against militarily-relevant bacterial diseases. Continue efficacy study of hybrid Shigella bacterial vaccine in animals. Examine alternative routes of administration of dengue 2 virus vaccine in primates. Initiate animal testing of candidate vaccines for dengue virus types 1, 3 and 4. Adapt Rickettsia tsutsugamushi (scrub typhus) to grow in cell substrates acceptable for human vaccine production.

3. (U) FY 1981 Planned Program: Continue preclinical testing of antiparasitic drugs. Emphasis placed on drugs for Mefloquine-resistant malaria and alternative drugs for prevention or treatment of leishmaniasis and African trypanosomiasis. Apply liposome drug delivery system technology to parasitic diseases other than leishmaniasis. Screen selected classes of compounds for broad antimicrobial activity and examine the mode of action of candidate prophylactic or therapeutic drugs. Advances in molecular virology indicate feasibility of developing effective drugs for prevention or treatment of incapacitating virus diseases. Studies will be initiated on formulation, leading to fielding, of effective antiviral compounds urgently needed to prevent or treat military relevant viral diseases which might lead to total operational mission failure, jeopardize readiness and strategic mobility, or impede mobilization or training. Coordinate toxicologic evaluation of topical and area repellents. Rank area repellents on basis of efficacy and persistence and determine impact of their use. Complete animal efficacy studies of gamma-irradiated African sleeping sickness vaccine and hybrid Shigella bacterial vaccine. Continue animal studies with pilus vaccines.

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Title: Prevention of Disease Affecting Troop Operation and Mobilization

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Title: Military Disease Hazards Technology

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Budget Activity: #1 - Technology Base

Continue vaccine development for dengue types 1, 3 and 4. Characterize growth kinetics of rickettsial organisms in cell culture to optimize yield for vaccine production. Standardize immune serum globulin for hepatitis A virus. Personnel to be utilized: 88 professional and 115 support.

4. (U) FY 1982 Planned Program: Expand studies on factors contributing to the broad range of host responses to infections. Screen selected doses of compounds for antimicrobial activity and examine the mode of action of candidate prophylactic and therapeutic drugs. Continue antiparasitic drug development; *emphasize malaria and* leishmaniasis. Evaluate utility of liposome drug delivery systems in parasitic diseases. Refine program leading to the development of a series of drug products effective against viruses of military concern. Select most promising topical and area repellents for final animal efficacy and toxicological testing. Continue animal efficacy studies of bacterial pilus vaccines. Complete developmental phase for dengue virus serotypes 1, 3 and 4 vaccines. Produce small pilot lots of gamma-irradiated vaccines for test in laboratory animals.

5. (U) Program to Completion: This is a continuing program.

6. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	12558	7809	7989	9706	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	12353*	9021*	8880*	-	Continuing	Not Applicable

This is a new technical area for FY 1981 under this Program Element/Project supporting research previously performed under Program Element/Project 6.27.70.A/A803 and A802 (in part), and Program Element/Project 6.27.72.A/A810. The remainder of the work previously supported under Project A802 is now supported under Program Element/Project 6.27.70.A/A870, Risk Assessment of Military Disease Hazards.

*Funds shown on FY 80 submission under Projects A802 and A803 for FY 1980 were $5021 and $4000, respectively. FY 1981 estimates for these efforts as shown on FY 80 submission were $4680 and $4200, respectively. The increase in FY 1979 represents transfer

Technical Area: #01

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of funds for increased costs at LAIR associated with a personnel reduction and for essential contracts in infectious disease research. The FY 1980 reduction in current requirements resulted from an equivalent reduction in Program Element 6.27.70.A directed by Congress. The FY 1981 decrease from last year's estimate results from budgetary decreases which will defer specific exploratory development efforts for drugs and vaccines until FY 1982.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical Area: #02 Title: Prevention of Biological Warfare Diseases
Project: #A871 Title: Prevention of Military Disease Hazards
Program Element: #6.27.70.A Title: Military Disease Hazards Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This program is designed to develop an effective medical defense against known and potential biological weapons. Data are utilized to formulate a total medical approach for prevention and treatment of biological warfare (BW) casualties. Program derives from militarily unique impact of specific diseases which are not of general concern to the United States civilian medical community. Forms the technological basis for formulation, advanced development, production, and testing of drugs, vaccines, and other biological means of protection against militarily important infectious diseases. Program develops therapeutic agents against diseases affecting strategic mobility for which there is no domestic market. This program is the only national resource for vaccine development specifically for armed services. Investigations in aerosol immunization and protection systems against BW and other hazardous infectious diseases are a significant component of this program.

B. (U) RELATED ACTIVITIES: Related Army studies are performed under Program Element 6.11.02.A, Defense Research Sciences; Program Element 6.27.70.A, Prevention of Military Disease Hazards, Project A870, Risk Assessment of Military Disease Hazards; and Program Element 6.37.50.A, Drug and Vaccine Development. Complementary infectious disease research is conducted by the Navy, National Institutes of Health, Department of Agriculture, and the Center for Disease Control. Army research does not duplicate these efforts. This program is also the sole DOD input in the national program for medical defense against biological agents. Army representation on Department of Defense coordinating committee and other intergovernmental agency coordination councils insures coordination at the working and administrative levels in order to prevent duplication of effort. Army scientists serve as consultants with the World Health Organization and have access to this organization's studies, reports, and publications. Other coordination is accomplished by personal contacts at the operating level, by site visits by project officers, organization of technical 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 resumes.

C. (U) WORK PERFORMED BY: Approximately 92% of the research is performed by the US Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD. Approximately 8% of the research is conducted under contract with universities, nonprofit organizations, and industry. The four major contracts are those with Brigham Young, Provo, UT; Yale University School of Medicine, New Haven, CT; Columbia University, New York, NY; and Johns Hopkins University, Baltimore, MD. Contracts are funded in the amount of $399,000.

Technical Area: #02 Title: Prevention of Biological Warfare Diseases
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D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Conducted studies in development of improved diagnostic capabilities: an assay procedure was developed for the Korean hemorrhagic fever virus; new serological techniques including radioimmunoassay, chemiluminescence and enzyme linked immunosorbant assay (ELISA) have been developed or modified for use in detecting BW infections; developed animal models for diagnosis and study of Tacaribe and Machupo viruses, disease agents of potential BW importance. Ribavirin, an antiviral drug, was found effective for treatment of Bolivian hemorrhagic fever in animal models. Emphasized program in improvement of development of new vaccines for military use: enhanced immunity to viral infections by using a metabolizable lipid adjuvant; a variant of Junin virus (Argentine hemorrhagic fever) was discovered which has potential as a vaccine candidate for Argentine (AHF) and Bolivian hemorrhagic fevers (BHF); prepared an attenuated Chikungunya virus vaccine in tissue culture; studies on the production and characterization of exotoxins from bacteria of military concern (viz: botulinum, anthrax) essential to the development of diagnostic procedures have been initiated.

2. (U) FY 1980 Program: Develop and refine improved rapid diagnostic procedures for arboviruses and other highly hazardous potential BW agents, including Ebola, Lassa, Congo-Crimean hemorrhagic and Rift Valley fevers. Develop animal models for diagnosis and study of Tacaribe and Machupo viruses, disease agents of potential BW importance. Evaluate Ribavirin, an antiviral drug, found effective for treatment of Bolivian hemorrhagic fever in animal models. Test the efficacy of antiviral agents in controlling Ebola virus infections. Conduct advanced investigations concerning infection mechanisms, host organ localization, cellular penetration and aerosol susceptibility to a variety of potential BW microorganisms. Evaluate the Junin virus variant as a candidate vaccine for Argentine hemorrhagic fever (AHF) and Bolivian hemorrhagic fever (BHF). Evaluate the efficacy of an attenuated Chikungunya virus vaccine in animals. Evaluate cross protection accorded Bunya virus infections by Rift Valley fever virus vaccine. Initiate animal testing of a candidate vaccine against Ebola virus, a newly described agent from Africa producing severe febrile illness in man. Further characterize the etiologic agent of Korean hemorrhagic fever (KHF) virus to determine the feasibility of preparing an effective vaccine. Apply available technology to preparation of an inactivated Lassa fever virus vaccine. Evaluate the potential for preparing a vaccine against Legionnaires' bacteria. Expand toxin exploratory development and technology base for protection against incapacitating effects of microbial toxins.

3. (U) FY 1981 Planned Program: Increase the capability of arbovirus reference centers to rapidly identify viral diseases and their vectors and to provide standardized reference reagents for Army field teams. Establish and equip mobile teams capable of evaluating and diagnosing potential or suspected BW incidents. Evaluate the transportability of patients and laboratory

Technical Area: #02 Title: Prevention of Biological Warfare Diseases
Project: #A871 Title: Prevention of Military Disease Hazards
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DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

specimens under total containment conditions. Complete evaluation of Junin virus variant as candidate vaccine. Continue efficacy testing of Chikungunya virus vaccine in animals. Further characterize cross protection of Rift Valley fever virus and other related viruses. Continue animal efficacy studies of candidate Ebola virus vaccine. Initiate testing of Korean hemorrhagic fever virus (KHF) vaccines in animals. Test an inactivated Lassa fever virus vaccine in animals. Continue development of a vaccine against Legionnaires' disease. Prepare candidate anthrax bacterial vaccines. Toxin producing organisms pose a major threat to US forces. Definitive research will be performed to more rapidly assess and develop appropriate improved antitoxins and vaccines to protect exposed military personnel. Personnel to be utilized: 141 professional and 180 support.

4. (U) FY 1982 Planned Program: Test laboratory microbiological capabilities using state-of-the-art procedures for the diagnosis of disease caused by diverse organisms and toxins. Conclude cross-protection studies with Rift Valley fever virus vaccines. Continue laboratory evaluations of Ebola, Chikungunya, Lassa fever, Korean hemorrhagic fever viruses and anthrax vaccine vaccines to assess safety and effectiveness. Perform safety and efficacy of Legionnaires' disease bacterial vaccine product. Initiate development of vaccines against highly virulent viruses (Marburg, Congo-Crimean) which may be encountered naturally or might be employed in BW environments. Assess and upgrade programmatic approach to protection from effects of toxin producing organisms.

5. (U) Program to Completion: This is a continuing program.

6. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	5272	4825	5717	6945	Continuing	Not Applicable
Funds (as shown in FY 1980	5272	4825	5717	-	Continuing	Not Applicable

This is a new technical area for FY 81 under this Program Element/Project supporting part of the research previously supported under Program Element 6.27.76.A, Medical Defense Against BW Agents. The remainder is supported under Program Element/Project 6.27.70.A/A870. The increases in the FY 1981 and FY 1982 estimates over FY 1980 estimated current requirements are required to offset inflation and permit the modest increases in effort described.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.72.A
Title: Combat Casualty Treatment Technology
DoD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	7303	8009	17197	18076	Continuing	Not Applicable
A812	Military Research Animal Resources	1038	0	0	0	-	1946
A874	Combat Casualty Treatment Technology	4510	4452	7024	7225	Continuing	Not Applicable
A875	Medical Systems in Nonconventional Environments	1755	3557	10173	10851	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is a restructured program. The program is directed toward the treatment of combat casualties resulting from conventional and nonconventional warfare and minimizing the vulnerability of troops to chemical warfare agents and ionizing radiation from nuclear weapons. This program responds to the threat posed by hostile forces trained and prepared to employ conventional as well as a wide variety of chemical and nuclear weapons. Such a battlefield is likely to product a greater number, severity, and dispersion of conventional and nonconventional combat casualties than previously experienced in modern times.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Funds requested will, in part, provide for improved wound healing, field-usable anesthesia techniques, resuscitative fluids and materiel for the field medical system. Funds are required for the development of medical technologies, resources and systems for the prevention, decontamination, treatment and evacuation of chemical warfare casualties. Request includes development of means to protect against the effects of nuclear warfare.

Program Element: #6.27.72.A Title: Combat Casualty Treatment Technology
DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	7303	8012	17195	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	7600*	6353*	6084*	Continuing	Not Applicable

*These funds were shown on the FY 1980 submission under Program Elements/Projects: 6.27.72.A/A814, Military Trauma and Resuscitation ($3465); 6.27.78.A/A838, Combat Medical Materiel ($998); and 6.27.80.A/A843, Medical Systems in Chemical Defense ($1890) for FY 1980. FY 1981 estimates for those projects on the FY 1980 submission were $3067, $1048, and $1969, respectively. FY 1979 figures include Program Element/Project 6.27.72.A/A812, Military Research Animal Resources. Decrease in FY 1979 represents transfer of funds to pay for essential research contracts. Congress added $1659 in FY 1980 to Program Element/Project 6.27.80.A/A843, to bring that program up to the originally planned level of effort. The FY 1981 increase over FY 1980 in Project A875 is required to develop a multidisciplinary effort for integrating and applying basic science information and technologies for exploratory development. This effort is needed to solve real-time problems that preclude the development of safe and effective decontamination, evacuation, and treatment systems for CW casualties. The effort complements Program Element 6.27.34.A, Medical Defense Against Chemical Agents. Beginning FY 1982, these programs will be consolidated for complete program integration and maximum utilization of resources. The FY 1981 increase in Project A874 reflects a revised estimate of funds required to conduct a minimum combat casualty care research program. This program was reoriented and redirected in FY 1979 toward requirements for far forward medical care to enhance medical systems readiness and enhance combat effectiveness by improving return to duty rate of combat casualties. Resources necessary to focus a minimum level of effort on improving battlefield thermal injury were underestimated.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.72.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Combat Casualty Treatment Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The program is responsive to aspects of the modern battlefield which are expected to produce a greater number, severity and dispersion of conventional and nonconventional combat casualties. This program is in part designed to improve field medical care ranging from location and diagnosis, through initial forward resuscitation and treatment, to evacuation and field hospital management. It is also structured to counter death, disability and ineffectiveness resulting from the use of chemical warfare (CW) agents. The program scope includes consideration of the threat of nuclear weapons and requirements for development of means to protect against or mitigate the effects of ionizing radiation. Specific project objectives are to improve return to duty rate, reduce resource utilization (e.g., personnel, equipment), reduce morbidity and mortality, and minimize the vulnerability of troops to CW agents. The project, Medical Systems in Nonconventional Environments, was initiated in FY 1979, to complement research conducted under DA Project AH26, Program Element 6.27.34.A, Medical Defense Against Chemical Agents. The two CW defense projects have been under the command and control of the Army Medical Department since 1 July 1979, and are managed as a single program. The intent is to fully integrate the two projects in FY 1982. This integrated CW defense program provides the critical bases for minimizing casualties from CW agents, assuring their rapid return to duty, and, thereby reducing the impact on combat resources.

G. (U) RELATED ACTIVITIES: This program has been restructured to align research directed toward improving care of combat casualties produced by conventional and nonconventional warfare. Research was previously accomplished under Projects A814, Military Trauma and Resuscitation, and A815, Combat Surgery; Program Element 6.27.78.A, Combat Medical Materiel; and Program Element 6.27.80.A, Medical Systems in Chemical Defense. Work under Program Element 6.24.34.A, Medical Defense Against Chemical Agents, which focuses on testing and evaluating, and individual prevention and therapy, is complementary to work in Project A875, Medical Systems in Nonconventional Environments. The two CW defense projects will be programmatically integrated for FY 1982. This program element contains, in part, items and systems that will progress to advanced and engineering development in related Program Element 6.37.32.A, Combat Medical Materiel, and Program Element 6.47.17.A, General Combat Support, respectively. Related science base in physiology with contributions from the areas of biochemistry, physics, pharmacology, microbiology, chemistry, toxicology, pathology and neurological sciences is provided under Program Element 6.11.02.A/Project BS10, Research on Military Diseases, Injury and Health Hazards. Research is closely coordinated with the programs of the National Institutes of Health and focuses solely on the unique problems of developing methods and materiels suitable to casualty care in the field. Research on human blood preservation and blood substitutes is carefully interfaced with Department of Navy. In the area of CW defense, related Army, Navy and Air Force programs, with Army as the executive agency, are coordinated to insure no duplication of effort.

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Title: Combat Casualty Treatment Technology
DoD Mission Area: #522 - Environmental and Life Sciences (ED)
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H. (U) WORK PERFORMED BY: Approximately 60% of the work is performed in-house at the Letterman Army Institute of Research, Presidio of San Francisco, CA; the Institute of Surgical Research, San Antonio, TX; the US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD; the US Army Biomedical Laboratory, Aberdeen Proving Ground, MD; and the Walter Reed Army Institute of Research, Washington, DC. Major extramural contracts are with the University of Kansas Medical Center, Kansas City, KA; Optical Sciences Group, Inc., San Rafael, CA; Vector Research, Inc., Ann Arbor, MI; Queens Medical Center, Honolulu, HI; and Regents of the University of California, La Jolla, CA. A total of 16 additional contracts are supported at a total dollar value of $1,317,000.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: In the area of conventional casualty care, investigators devised an experimental method for the synthetic repair of small bowel injury; developed a data base on the interaction of anesthetic agents with hemorrhage; and identified two tests which have potential as field usable detectors of the injured at greatest risk for sepsis. Initial tests indicate that an improved blood preservation system, CPD-A2, should be capable of extending by six-fold the military field blood storage time. Conducted initial animal studies on stroma-free hemoglobin, a potential blood substitute. Initiated a study to establish concept and criteria for developing a tactical field ambulance. The Medical Systems in Nonconventional Environments project was initiated in FY 1979. Specific studies initiated included: review and evaluation of pharmacologic approaches to the prevention and treatment of chemical warfare (CW) casualties resulting in a recommendation to change existing medical doctrine for the prevention and treatment of nerve agent poisoning; review of current concepts for the prevention, treatment and management of chemical casualties to identify critical knowledge gaps in the existing science base; and review of concepts and technologies to establish a basis for testing potential antiradiation compounds. Established the determinations and findings for an extramural contract program in support of the US Army Medical Research and Development Command's Chemical Defense Program.

2. (U) FY 1980 Program: Continue ongoing efforts to determine the mechanisms of wounding and healing, to include those associated with injury induced by blunt and penetrating trauma, blast overpressure, and toxic fumes. Identify anesthetic agents specifically for use when blood loss is a surgical complication. Continue development of improved blood preservation systems, blood substitutes, and improved resuscitative fluids for use in the combat area. Additional efforts include development of anti-shock drugs and rapid diagnostic triage techniques. Conduct research in the areas of inhalation injury, post-burn infection and burn wound healing to include small, critical area burns. Continue exploratory development of high priority medical materiel items for application in the areas of diagnosis, treatment and evacuation, and insect control and eradication. Initiate efforts

Program Element: #6.27.72.A
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to establish and develop standards for the screening of new protective and therapeutic drugs and antidotes for the prevention and treatment of poisoning from CW agents. Initiate a comprehensive review of recent advances in pharmaceutical research and formulations leading to development of a rational basis for selecting and screening compounds directed at protecting the soldier against CW injuries. Begin development of the concepts and scientific data base required to predict and establish the stability of antichemical drugs to assure drug potency during storage under a variety of field conditions. Review bioengineering concepts and technologies leading to establishment of medical materiel design characteristics for the decontamination, evacuation and treatment of chemical casualties. Evaluate the means of administering antichemical drugs for usability and reliability under field conditions at each level of medical care to include soldier self-administration. Continue development and screening of chemoprotective drugs to mitigate the effects of ionizing radiation.

3. (U) FY 1981 Planned Program: Continue research on improving the treatment of wounds resulting from fielded and anticipated weapons systems. Specific studies will address methods of treatment for new classes of injuries resulting from blast overpressure, toxic fumes, and lasers. Initiate new efforts to develop skin substitutes. Expand development of field usable anesthesia techniques. Anticipate progress in the development of early, field applicable indicators of injured or diseased states. Increase emphasis on the development of resuscitative fluids, essential to a far forward battlefield treatment regime. Level of effort in the development of improved blood preservation systems promises to extend blood shelf-life up to six-fold. Continue development of a life-sustaining blood substitute with focus on improving the stroma-free hemoglobin solution. Maintain projects to develop anti-shock drugs. Improve methods for treatment of battlefield thermal injury with emphasis on inhalation injury, post-burn infection and small, critical area burns. Develop medical materiel items required by the field medical system in the areas of diagnostic and special purpose equipment, treatment and evacuation, and insect control. The objectives of the CW defense program include continued development and screening of known chemoprotectives, antidotes and chemotherapeutic drugs for the prevention and treatment of poisoning from CW agents. Initiate synthesis of new compounds and develop novel concepts for the prevention and treatment of CW injuries based on developing science data base. Expand programs to include preclinical testing to develop the pharmacologic, toxicologic, and pathologic data on candidate drugs required to support a petition for safety and tolerance testing in volunteer human subjects. Develop formulations of candidate drugs that optimize delivery, absorption and efficacy. Expand the data base on new and existing medical materiel for possible incorporation into medical systems for decontamination and treatment of CW casualties and conduct feasibility studies on foreign medical materiel for potential adoption or modification in the decontamination, evacuation and treatment systems of CW casualties. Establish concepts for medical systems that are responsive to combined conventional and nonconventional injury. Explore concepts for the design of a respiratory resuscitation system capable of supporting large numbers of casualties. Direct efforts toward establishing the physiological and behavioral limitations imposed on casualties and medical personnel by antichemical drugs, decontamination procedures and protective clothing/devices. Continue level of effort to identify drugs for protection against or mitigation of the effects of nuclear warfare. Personnel to be utilized: 144 professional and 248 support.

Program Element: #6.27.72.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Combat Casualty Treatment Technology
Budget Activity: #1 - Technology Base

4. (U) FY 1982 Planned Program: Emphasis on increasing medical system adaptability and improving capabilities for care at all echelons of the field medical system will continue to include the development of improved blood and resuscitative fluids; determination of injury and healing mechanisms with emphasis on treatment of new wound classes (e.g., lasers, blast overpressure, toxic fumes, blunt and penetrating trauma), development of triage criteria, resuscitative techniques and medical materiel suitable for forward use; and studies to delineate the appropriate use of anesthetic agents in field settings. Current plans are to consolidate research efforts of DA Project A875, Medical Systems in Nonconventional Environments, and H26, Medical Defense Against Chemical Agents, for more efficient management and utilization of resources. Program is to continue the evaluation and selection of new chemoprotectives, antidotes, and chemotherapeutic drugs for advanced testing. Continue technology research of new and existing medical materiel for utilization in medical systems for decontamination and treatment of CW casualties. Emphasize reformulations of promising drugs to determine their potential for mitigating the effects of ionizing radiation.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A874 Title: Care of the Combat Casualty
Program Element: #6.27.72.A Title: Combat Casualty Treatment Technology
DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The modern battlefield with increased mobility and sophisticated weaponry will produce an increase in the number and severity of combat casualties across traditional and new casualty categories. Highly mobile operations will result in a greater dispersion of casualties. The modern battlefield, therefore, demands an equally mobile and adaptable medical system. Shortages of combat, combat support and combat service support personnel are also anticipated. Casualties that are returned to duty will represent a major source of combat replacements, especially under a short-term battle scenario in which replacements would be in short supply or nonexistant. Personnel shortages on the mobile battlefield will require maximum utilization of medical personnel and simplified techniques and materiel for use by non-physicians. The goal of the project is to improve the field medical care for the injured soldier, ranging from location and diagnosis, through initial forward resuscitation and treatment, to evacuation and field hosptial management. Research is directed toward the following objectives: (1) improve return to duty rate, (2) reduce resource utilization and impact on personnel and logistical systems, and (3) reduce morbidity and mortality.

B. (U) RELATED ACTIVITIES: This project has been restructured to align research directed toward improving combat casualty care. Research was previously accomplished under Projects A814, Military Trauma and Resuscitation, and A815, Combat Surgery, of this program element, and Program Element #6.27.78.A, Combat Medical Materiel. Medical materiel development in support of requirements to provide CW defense is conducted under Project A875, Medical Systems in Nonconventional Environments. This project contains, in part, items and systems that will progress to advanced and engineering development in related Program Element #6.37.32.A, Combat Medical Materiel, and Program Element #6.47.17.A, General Combat Support, respectively. Related science base in physiology with contributions from the areas of biochemistry, physics, pharmacology, microbiology, chemistry, toxicology, pathology and neurological sciences is provided under Program Element #6.11.02.A/Project BS10, Research on Military Diseases, Injury and Health Hazards. Research is closely coordinated with the programs of the National Institutes of Health and focuses solely on the unique problems of developing methods and materiels suitable to casualty treatment in the field. Research on blood and plasma replacements are also carefully interfaced with Department of Navy.

C. (U) WORK PERFORMED BY: Approximately 75% of the work is performed in-house at the Letterman Army Institute of Research, Presidio of San Francisco, CA; the Institute of Surgical Research, San Antonio, TX; and the US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD. Major extramural contracts are with Vector Research, Inc., Ann Arbor, MI; Queens Medical Center, Honolulu, HI; Regents of the University of California, La Jolla, CA; Scripps Clinic and Research Foundation, La Jolla, CA; and Yale University, New Haven, CT. A total of 14 additional contracts are supported at a total dollar value of $1,174,000.

Project: #A874 Title: Care of the Combat Casualty
Program Element: #6.27.72.A Title: Combat Casualty Treatment Technology
DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Investigators developed an experimental method for the synthetic repair of small bowel injury. A data base was developed to determine the interaction of anesthetic agents with hemorrhage in developing concepts for field usable anesthetic techniques. An antiserum for the prevention and treatment of gram-negative sepsis and shock has been moved into clinical trials. Such an antiserum could greatly reduce the morbidity associated with combat injury. A two year effort has to date identified two tests which have potential as field usable detectors of the injured at greatest risk for sepsis. Studies demonstrated that CPD-A2, an improved blood preservation system, could potentially extend the military field blood storage time six-fold. Animal studies were initiated on a potential blood substitute, stroma-free hemoglobin. A study was initiated to establish concepts and criteria for developing a tactical field ambulance.

2. (U) FY 1980 Program: Major accomplishments are anticipated in improving techniques for enhancing the healing process of injuries resulting from blunt and penetrating trauma, blast overpressure effects, and toxic fumes. Research will continue to be directed toward development of field-usable anesthetic techniques. Recommendations for which anesthetic agents to use after traumatic blood loss are anticipated. Resources are programmed to continue development of improved blood preservation systems, development of blood substitutes, and improved resuscitative fluids. Additional efforts will include determining systemic response to injury, development of anti-shock drugs, prevention and treatment of wound infection, and development of rapid diagnosis/triage techniques. Studies to improve the treatment of battlefield thermal injury will continue. Research projects are anticipated in the areas of inhalation injury, post-burn infection, and burn wound healing to include small, critical area burns. Exploratory development of high priority materiel requirements are programmed in the areas of diagnostic and special purpose equipment, treatment and evacuation, and insect control and eradication.

3. (U) FY 1981 Planned Program: Research will continue to focus on the improved treatment of wounds resulting from fielded and anticipated weapons systems. Specific studies will investigate pulmonary injury from blast overpressure and toxic fumes and seek to develop appropriate treatment methods. New studies will address acute laser injury with initial efforts directed toward development of an appropriate animal model. Research on wound healing will be expanded to include development of skin substitutes. Efforts are programmed to develop field usable anesthetic techniques. Specific accomplishments are anticipated in the development of early, field applicable indicators of injured or diseased states. Increased emphasis will be placed on the development of resuscitative fluids, essential to a far forward battlefield treatment regime. Level of effort in the development of improved blood preservation systems promises to extend blood shelf life up to six-fold. Development of a life sustaining blood substitute will continue with focus on improving the stroma-free hemoglobin solution. Major efforts will seek to determine the systemic response to injury (e.g., shock) and to maximize patient stabilization to include focus on the development of anti-shock drugs.

Project: #A874 Title: Care of the Combat Casualty
Program Element: #6.27.72.A Title: Combat Casualty Treatment Technology
DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

Efforts directed toward improvement of methods for treatment of battlefield thermal injury will continue with emphasis on inhalation injury, post-burn infection and small, critical area burns. Medical materiel items required by the field medical system will be developed in the areas of diagnostic and special purpose equipment, treatment and evacuation, and insect control. Efforts will be expanded to develop concepts and criteria for development of a tactical field ambulance and a field clinical laboratory. Personnel to be utilized: 138 professional and 237 support.

4. (U) FY 1982 Planned Program: Program emphasis will continue to be toward increasing medical system adaptability and improving capabilities for care at all echelons of the field system. Program will contain development of improved blood and resuscitative fluids; determination of wound healing and treatment methods with emphasis on new wounding techniques (e.g., lasers, blast, toxic fumes, blunt and penetrating trauma) and delayed definitive treatment; development of triage criteria, resuscitative techniques and medical materiel suitable for forward use; and studies to delineate the appropriate use of anesthetic agents in field settings.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not applicable.

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	4510	4452	7024	7225	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	5145*	4463*	4115*	-	Continuing	Not Applicable

*These funds were shown on FY 80 submission under Project A814, Military Trauma and Resuscitation ($3465 in FY 80) and Program Element 6.27.78.A, Combat Medical Materiel ($998 in FY 80). FY 81 estimates for those PEs/Projects on the FY 80 submission were $3067 and $1048, respectively. FY 1979 figures also include Program Element/Project 6.27.72.A/A812, Military Research Animal Resources. Decrease in FY 1979 represents transfer of funds to pay for essential contracts in environmental research. The

Project: #A874
Program Element: #6.27.72.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Care of the Combat Casualty
Title: Combat Casualty Treatment Technology
Budget Activity: #1 - Technology Base

Increase in FY 1981 reflects revised estimate of monies required to conduct a minimum combat casualty care research program. The program was reoriented and redirected in FY 1979 toward requirements for far forward medical care to enhance medical system readiness and enhance combat effectiveness by improving return-to-duty rate of combat casualties. Resources necessary to focus a minimum level of effort on improving battlefield thermal injury were underestimated.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A875 Title: Medical Systems in Nonconventional Environments
Program Element: #6.27.72.A Title: Care of the Combat Casualty
DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This is a restructured Project that was initiated in FY 1979 to complement research conducted under Program Element 6.27.34.A, Medical Defense Against Chemical Agents. The research objectives are to minimize the vulnerability of troops to chemical warfare (CW) agents by developing medical concepts, technologies, resources and systems for the prevention, decontamination, treatment and evacuation of CW casualties. The two programs have been under the command and control of the Army Medical Department since 1 July 1979, and are managed as a single program; therefore, the intent is full integration of the two programs in FY 1982. This integrated CW defense program provides the critical basis for minimizing CW casualties, assuring their rapid return to duty, and, thereby reducing the impact on combat resources. The project scope also considers the threat of nuclear weapons and requirements for development of means to protect against or mitigate the effects of ionizing radiation.

B. (U) RELATED ACTIVITIES: Research was previously performed under Program Element 6.27.80.A, Medical Systems in Chemical Defense. Basic research in support of the Program Element is defined under Program Element 6.11.02.A, Project BS10, Military Diseases, Injury and Health Hazards. Complementary work under Program Element 6.27.34.A, DA Project H26, Medical Defense Against Chemical Agents, focuses on testing and evaluating, and individual prevention and therapy. Related Army, Navy and Air Force programs, with Army as the executive agency, are coordinated to assure no duplication of effort. Coordination with other services is via Ad Hoc Joint Service Chemical-Biological RDTE Requirements Prioritization Committee.

C. (U) WORK PERFORMED BY: Research is performed in-house at the US Army Biomedical Laboratory, Aberdeen Proving Ground, MD; Walter Reed Army Institute of Research, Washington, DC; and at the US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD. Extramural contracts are with University of Kansas Medical Center, Kansas City, KA; Optical Sciences Group, Inc., San Rafael, CA; SRI International, Menlo Park, CA; and Life Sciences, Inc., Cleveland, OH.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Program started in FY 1979. Initiated studies to: review and evaluate pharmacologic approaches to the prevention and treatment of chemical warfare (CW) casualties that resulted in a recommendation to change existing medical doctrine for the prevention and treatment of nerve agent poisoning; review the current concepts for the prevention, treatment and management of chemical casualties in order to identify critical knowledge gaps in the existing

Project: #A875 Title: Medical Systems in Nonconventional Environments
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DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

science base; review existing technologies for the timely and effective decontamination of chemical combat casualties that minimizes personnel resource requirements; establish the basis for testing potential antiradiation compounds; establish military channels for the exchange of information regarding the needs and requirements for the US Army Chemical Defense Program. Established the determinations and findings for an extramural contract program in support of the US Army Medical Research and Development Command's Chemical Defense Program.

2. (U) FY 1980 Program: The objectives of the 1980 program are to: initiate development and establishment of standards for the screening of new chemoprotectives, antidotes and chemotherapeutic drugs for the prevention and treatment of poisoning from CW agents; initiate comprehensive review of recent advances in pharmaceutical research and formulations in order to begin development of a rational basis for selecting and screening compounds directed at protecting the soldier against CW injuries; initiate development of the concepts and scientific data base required to predict and establish the stability of chemoprotectives, antidotes and chemotherapeutics in order to assure potency during storage under a variety of field conditions; initiate review of bioengineering concepts and technologies in order to begin establishing medical materiel design characteristics based on identified requirements for the decontamination, evacuation and treatment of CW casualties; evaluate the means of administering chemoprotectives, antidotes and chemotherapeutics for usability and reliability under field conditions at each level of medical care to include soldier self-administration; and, development and screening of chemoprotective drugs to mitigate the effects of ionizing radiation. Implement the extramural contract program that supports the medical research objectives of the chemical defense program.

3. (U) FY 1981 Planned Program: The objectives of the FY 1981 program are to: continue development and screening of known chemoprotectives, antidotes and chemotherapeutic drugs for the prevention and treatment of poisoning from CW agents; begin synthesis of new compounds and develop novel concepts for the prevention and treatment of CW injuries based on developing science data base; develop analytical procedures and expand programs to include preclinical testing in order to develop the pharmacologic, toxicologic and pathologic data on candidate drugs required to support a petition for safety and tolerance testing in volunteer human subjects; develop formulations of candidate drugs that optimize delivery, absorption and efficacy; expand the data base on new and existing medical materiel for possible incorporation into medical systems for decontamination and treatment of CW casualties; conduct feasibility studies of foreign medical materiel for adoption or modification in the decontamination, evacuation and treatment systems of CW casualties; establish concepts for developing medical systems that are responsive to combined conventional and chemical casualties; develop specialized medical devices for monitoring the vital signs of CW casualties that do not require removal of their chemical protective materiel; explore concepts and technologies required to

Project: #A875 — Title: Medical Systems in Nonconventional Environments
Program Element: #6.27.72.A — Title: Care of the Combat Casualty
DoD Mission Area: #522 - Environmental and Life Sciences (ED) — Budget Activity: #1 - Technology Base

design a respiratory resuscitative system capable of supporting large numbers of casualties; establish the physiological and behavioral limitations imposed on casualties and medical personnel by antidotes, chemoprotectives, chemotherapeutics, decontamination procedures and protective clothing/devices; develop biomedical criteria for classification and sorting of CW casualties; develop biomedical criteria for predicting extent and duration of morbidity of CW casualties; establish and maintain a repository for all available biomedical data concerning the effects and characteristics of CW agents, antidotes, chemoprotectives and chemotherapeutic drugs; and establish a technology/information transfer service for not only in-house and contractor use, but also for the timely transfer of information to the user community. Personnel to be utilized: 6 professional and 11 support.

4. (U) FY 1982 Planned Program: Current plans are to consolidate research efforts of this program with Program Element 6.27.34.A, Project H26, Medical Defense Against Chemical Agents, for more efficient management and utilization of resources. Continue to evaluate and select new chemoprotectives, antidotes and chemotherapeutic drugs for advanced testing. Continue technology research of new and existing medical materiel for utilization in medical systems for decontamination and treatment of CW casualties. Continue reformulations of promising drugs to determine their potential for chemoprophylaxis.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable.

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	1755	3557	10173	10851	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	1800*	1890*	1969*	-	Continuing	Not Applicable

*These funds were shown on the FY 1980 submission under Program Element 6.27.80.A, Medical Systems in Chemical Defense. Congress added $1610 for FY 1980 to bring the program up to the originally planned level of effort (as shown in FY 1979 summary).

Project: #A875
Program Element: #6.27.72.A
DoD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Medical Systems in Nonconventional Environments
Title: Care of the Combat Casualty
Budget Activity: #1 - Technology Base

Decrease in FY 1979 represents transfer of funds for essential contracts in infectious disease research. FY 1981 increase is requested to meet immediate requirements for: unique and supplemental instruments and equipment; scientific and technical cadre in a multitude of disciplines to expand from a toxicological program to a comprehensive program embodied in physiology, pharmacology, biochemistry and neuroscience; expanded military in-house and extramural academic program to develop required science base; cataloging, analyzing and integrating existing science bases; and, providing rapid medical solutions to field problems by integrating and assessing the threat &nalysis and US and foreign technology, chemoprotectives, antidotes, chemotherapeutics and doctrine.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.75.A Title: Combat Maxillofacial Injury
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1280	1253	762	812	Continuing	Not Applicable
A825	Combat Maxillofacial Injury	1280	1253	762	812	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program is required to develop optimum methods for maxillofacial combat casualty management; to establish rapid, effective methods of treating oral disease and putting the soldier in a dental readiness state; to achieve minimal morbidity rates and lost time due to oral related emergencies, preventable oral disease, and dental material failures; to develop more efficient, simplified, and effective means of protecting the oral health and maxillofacial apparatus from disease and trauma.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: To continue studies to acquire data necessary to alleviate problems associated with care of maxillofacial combat injuries and to prevent oral disease.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL BUDGET REQUESTS: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE	1280	1253	762	Continuing	Not Applicable
Funds (current requirements)	1260	1260	1269	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)					

Program Element: #6.27.75.A Title: Combat Maxillofacial Injury
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

Basis for change: Increase in FY 1979 required to fund an essential research contract. Decreased funding profile between FY 1980 and FY 1981 submission is due to a redefinition of the Dental/Maxillofacial research. Some research previously supported under this program element will be supported under program elements 6.27.70.A, Military Disease Hazards Technology, and 6.27.72.A, Combat Casualty Care Technology, in FY 1981.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.75.A Title: Combat Maxillofacial Injury
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of research in the maxillofacial sciences is primarily aimed at solving problems of the soldier in the field, and is based on the following: for each 1,000 recruits, 6,200 restorations, 2,360 extractions, and 136 removable dentures are necessary to be qualified as "ready". In Vietnam, 46.6 percent of all personnel killed in action were the result of head and neck wounds, 13-14 percent of all injuries involved head and neck regions; in CONUS field exercises, 22.3 percent of all medically related emergencies were of dental origin. In order to put and maintain the soldier in a dental readiness state, more rapid and effective methods of treating oral emergencies are essential.

G. (U) RELATED ACTIVITIES: Army efforts related to this program are performed under Program Element/Project 6.11.02.A/S10, Research on Military Disease Injury and Health Hazards. In addition, related research at the US Army Institute of Dental Research is conducted in support of Program Element 6.27.70, Military Disease Hazards Technology; and Program Element 6.27.72, Combat Casualty Care Technology. Related, but nonduplicative research is conducted by the US Navy, US 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 two study sections of the National Institute of Dental Research. Representatives of the three services meet annually with the National Institute of Dental Research.

H. (U) WORK PERFORMED BY: The in-house effort is conducted by the US Army Institute of Dental Research, Washington, DC. Assistance is provided by the Chemical Systems Laboratory, Edgewood Arsenal, Aberdeen Proving Ground, MD. The top five extramural contractors are: Battelle Memorial Institute, Columbus, OH; Solid Photography, Inc., Millville, NY; University of Alabama, Birmingham, AL; Polymer Research Corp., Brooklyn, NY; and the Franklin Institute Research Laboratories, Philadelphia, PA. Three additional contracts are supported at a cost of $137,000.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Animal studies with heavy metal toxicants indicate a new material (Na2,3 Dimercaptopropane sulfonate, DMPS) is at least 10 times more efficient as a detoxicant than some presently used and has much less toxicity. Asbestos health hazards in Army dental laboratories were identified and information on protection distributed to the field. Beryllium and nickel hazards in military dental practice were shown to be significant; data on hygiene and prevention was published in the national literature. The ability of biodegradable copolymers to act as a carrier for bone repair agents for use in wound healing and as a slow-release vehicle for drugs to combat wound infection has been proven and a product delivered for testing in animals and humans. True micro-encapsulation of various drugs utilizing biodegradable copolymers has been achieved and

Program Element: #6.27.75.A Title: Combat Maxillofacial Injury
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

they are presently being animal tested. The wound morphology of high velocity missiles in tissue simulants demonstrated the need for a computerized technique for application to man; further studies have demonstrated that a reassessment of current management procedures for maxillofacial combat injuries is required. Biodegradable, custom fabricated, hollow organ replacements have been used to repair and replace traumatically avulsed segments of the esophagus in animals. The use of nitinol metal for fixation of mandibular fractures in animals resulted in superior wound healing rates and is applicable for use in maxillofacial surgery. Neodynium lasers were utilized to weld fixed dental appliances in mammals; histological results are being evaluated. A controlled study of endemic disease in South America having potential oral manifestations was initiated; results will determine need for worldwide studies. Completed animal studies have shown that metal deposition on teeth prevents decay in animals; a new study was initiated to test the anticarious activity in humans. Epidemiologic assessment indicates there are at least 22 different diseases which could impact on the oral health of troops deployed in South America. A miniaturized bacterial identification system was tested and found to be an adequate substitute for older, slower, bulkier and more expensive identification methods. Methods have been developed which will control the exposure of a soldier to toxic microbiologic contaminants during the delivery of dental care in a hostile environment. A spoon-tooth brush combination was fabricated and evaluated in field tests as an aid to oral hygiene; initial tests were highly encouraging and indicate this tool may be a prime method of preventing dental disease in the field.

2. (U) FY 1980 Program: Continue in-house studies to develop field salivary diagnostic tests for the detection or presence of specific types of chemical warfare agents. Continue detection and assessment of airborne pollutants in Army laboratories. Develop human use protocol for DMPS as a heavy metal detoxicant. Further develop 3-dimensional imagery for identification of combat fatalities and transmission of data for more rapid surgical treatment of avulsive wounds. Evaluate a portable x-ray intensification device for use in combat situations. Continue collection of data for computer analysis on the effects of high velocity missile wounds as related to missile mass energy in the maxillofacial complex. Continue research in true microencapsulation of drugs in copolymers as variable time release delivery vehicles. Initiate studies to rapidly identify viable and nonviable tissue in avulsive wounds of the head and neck in order to improve wound management methodology. Continue studies of hollow organ repair/replacement using biodegradable copolymers. Initiate studies for the segmental repair of the trachea due to traumatic tissue loss. Initiate studies to evaluate effectiveness of tricalcium phosphate with autogenous bone as an expander. Continue collection of human data with implants, both as a fracture fixation device and single tooth replacement. Continue mechanical and metallographic characterization of proprietary precious, semiprecious, and base metal alloys for potential military application and cost saving. Continue studies using nitinol as a fracture fixation device in animals. Initiate human studies using chemical metal plating techniques for oral disease prevention and potential for dental restoration in the combat soldier. Assess static pressure casting techniques for base metal alloys. Develop a closed system for field dental units that will maintain fluid sterility and hydrodynamic efficiency. Continue project to provide rapid determination of specific bacterial

Program Element: #6.27.75.A Title: Combat Maxillofacial Injury
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

contamination of oral combat type wounds. Continue epidemiologic investigations of oral diseases in South America. Initiate psychological studies to determine causes for soldiers not actively seeking or accepting free dental care.

3. (U) FY 1981 Planned Program: Research will concentrate on continuing studies to solve dental problems of the soldier in the field. Principle efforts will be to continue research on high velocity missile wound defects of the maxillofacial complex and use of 3-dimensional imagery in diagnosis/treatment of avulsive wounds of the head and neck. Level of research effort will continue on: use of lasers for maxillofacial wound surgery and treatment of certain surface lesions; characterization of biodegradable/biocompatible materials for maxillofacial wounds and wound repair to include studies of tricalcium phosphates as bone extenders; use of ceramics in osseous wounds and use of polymer microcapsules and special surgical devices as matrices in surgical defects; investigations of methods to identify vaible tissue and inhibit bone loss/restoration in combat wounds of the head and neck; human studies of implants as fracture fixation devices and tooth replacements; characterization of mechanical and biological properties and metallographic features of metallic materials; investigations of powder metallurgy, nickel, titanium and other base, semiprecious and precious alloys, dental amalgam, and resins and composite restoratives; evaluation of static pressure casting techniques for base metal alloys; epidemiology of South American diseases having oral manifestations; efficacy of slow-release drug vehicles and their feasibility for use in remote combat areas; development of dental disinfectants/sterilants for use in the field; prevention or protection against airborne pollutants in dental facilities; and studies of dental care psychology. New initiatives include: rapid exploitation of research advances on biodegradable substances; development of design criteria for devices to protect the maxillofacial complex; determination of the relationship between oral microflora, oral disease and geographical location of the soldier; and development of manual or oral hygiene measures for prisoners of war. Also a new research effort will be initiated to better understand the relationships between age, education, nutrition, previous dental knowledge, poor oral health habits and tooth decay/peridontal problems. Efforts to evaluate and improve the methods of oral hygiene instruction will be included. Personnel to be utilized: 27 professional and 41 support.

4. (U) FY 1982 Planned Program: Complete work on maxillofacial tissue responses to high and ultrahigh velocity missile studies, computer man characterization of wound parameters, uses of 3-dimensional imagery in trauma. Continue biodegradable/biocompatible copolymer and ceramic studies, implant evaluations and wound healing/contamination efforts. Continue/initiate studies/evaluations on dental materials as related to the unique military situation, wound healing/contamination, oral disease epidemiology.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology

DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	8078	15001	13258	13861		
A878	Health Hazards of Military Materiel	3654	9430	6586	6881	Continuing	Not Applicable
A879	Medical Factors Limiting	4424	5571	6672	6980	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is a restructured Program Element. The goal of this research is to foster and maintain operational readiness and combat effectiveness by preserving the health, well-being, and physical and mental fitness related to operational and occupational factors, weapons systems features, and environmental quality. Research is directed toward the identification and solution of operationally significant health problems and to providing timely input to health policymakers and combat and materiel developers. Combat developer requirements are driving development of new materiel technologies which may exceed soldier performance capabilities and physiological/psychological tolerance. New health threats and combinations of stressors with unique and compounded hazards reduce overall system effectiveness and make the soldier the weak link.

C. (U) BASIS FOR THE FY 1981 RDTE REQUEST: The FY 1981 planned program consists of a coordinated matrix of projects aimed at the prevention of Health Hazards of Military Systems. The program is driven by increasing medical concerns and Army requirements which have resulted from rapidly advancing technological developments. The technological data base is required in order to generate medical information which will provide guidelines for the development of policy and doctrine aimed at protecting the soldier from exposure to unacceptable health risks unique to military systems, to enhance soldier performance and minimize performance degradation, to comply with federal law and promote and maintain a readiness posture.

Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	8078	15001	13258	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	8128	16053*	28300*	Continuing	Not Applicable

This is a restructured program for FY 1981 resulting from consolidation of the following Program Elements/Projects: 6.27.71.A, Military Psychiatry and Microwave Injury; 6.27.73.A, Helicopter, Combat Crew and Airborne Medicine; 6.27.77.A, Military Environmental Stress; and 6.27.72.A/A813, Recovery from Injury/Health Effects of Military Lasers.
*Funds were shown in FY 1980 submission under Program Element 6.27.71.A ($4500); Program Element 6.27.73.A ($2915); Program Element 6.27.77.A ($6590); and Program Element/Project 6.27.72.A/A813 ($1492). FY 1981 estimates as shown in the FY 1980 submission for those Program Elements/Projects were $8998, $3722, $4331, $2947, and $8302, respectively. The decrease in FY 1979 resulted from adjustments made near the end of the fiscal year to make maximum utilization of available funds. The decrease in FY 1980 current requirements, compared to previously submitted estimate is the result of Congressional reductions in 6.27.71.A/A804, Military Psychiatry and 6.27.72.A/A813, Health Effects of Military Lasers. The decrease in the FY 1981 estimate represents a reduced level of effort resulting from budgetary decisions which have led to deferral of anticipated new starts in FY 1981.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Combat requirements are driving development of new materiel technologies which may pose serious health hazards or which may markedly impair the capacity of the soldier to function under a variety of adverse environments, stressors or heightened performance demands. Health hazard assessment must be considered early in the design of emerging systems to ensure that human tolerances are not exceeded during their employment. The technical data base must be expanded to support the rational development of policy and directives which govern training and operational use of systems which are potentially hazardous to the user or which may degrade performance. Program emphasis is on exploratory development to: define physiological limits of individual human tolerance and biological impact of developmental and prototype military materiel systems and technologies; develop injury prevention and health protection criteria and technologies for use by health policymakers and materiel developers and testers; determine physiologic risk to immediate and long-term health resulting from system generated health hazards. This program also addresses exploratory development of medical factors limiting soldier effectiveness in order to assess soldiers' physical/physiological/psychological capabilities to function effectively under environmental and operational stress; and prevent adverse effects of stress on health, safety and performance by means of selection criteria, protective equipment and operational measures. Research areas include auditory and systemic effects of impulse and steady state noise, physiological effects of combat vehicle vibration/impact/crash-worthiness/life support equipment/clothing and crew stations, and micro-environmental heat and cold stress; health effects of electromagnetic radiation from laser, microwave and millimeter wave systems; toxic hazards to troops exposed to combustion products/contaminants during field use of smokes/obscurants and weapons systems, and for Army industrial workers during manufacture and demilitarization of munitions; neuropsychiatric factors resulting from continuous or sustained high intensity conflict/rapid mobility deployment and jet-lag, military-unique drug and alcohol abuse medical research requirements, and environmental factors relating to first enlistment attrition and female soldier maladjustment; combat crew performance enhancement factors related to the impact of environmental extremes on performance and enhanced physiologic/psychologic acclimatization to heat/cold/altitude, development of task performance/workload criteria and physiologic/psychologic indices of aviator alertness/fatigue, and assessment of visual problems involved in integrating man with electro-optical systems/heads-up displays/complex weapons systems and night operations; physical fitness and selection factors involving development of physical fitness standards for sedentary and physically demanding military occupational specialties (MOS), validation and refinement of physical fitness standards for all military occupational specialties, and establishment of Army aircrew selection, retention and physical performance criteria.

G. (U) RELATED ACTIVITIES: This is a restructured program which was consolidated to best utilize existing technologies. Research efforts for this program element were previously funded under Program Elements/Projects: 6.27.71.A/A804, Military Psychiatry; 6.27.71.A/A805, Microwave Injury; 6.27.72.A/A813, Health Effects of Military Lasers; 6.27.73.A/A819, Helicopter, Combat Crew and Airborne Medicine; 6.27.71.A/A845, Military Environmental Stress; and 6.27.77.A/A846, Toxic Hazards of Military

Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
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Environments. Toxic chemical hazard assessment is closely coordinated and complemented by Program Element 6.11.02.A/BS04, Identification and Health Effects of Military Pollutants; and 6.27.20.A/A835, Environmental Quality Technology. Basic science research is performed under Program Element 6.11.02.A/BS10, Research on Military Diseases, Injury and Health Hazards. Technology transfer, research coordination and collaboration, and minimization of duplication of effort is achieved through intra-Army and tri-service agreements, regulations and informal meetings.

H. (U) WORK PERFORMED BY: In-house research is conducted by the US Army Aeromedical Research Laboratory, Fort Rucker, AL; Letterman Army Institute of Research, Presidio of San Francisco, CA; Walter Reed Army Institute of Research, Washington, DC; US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD; US Army Research Institute of Environmental Medicine, Natick, MA. The top five contractors include: Battelle Pacific North West Laboratories, Richland, WA; IIT Research Institute, Chicago, IL; Oak Ridge National Laboratories, Oak Ridge, TN; Arthur D. Little, Cambridge, MD; and Virginia Commonwealth University, Richmond, VA. There are 17 additional contractors at a cost of $1,124,000.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Developed models for assessment of acoustic, vibration and blast overpressure (impulse noise) hazards related to new tracked armored vehicles (XM-1 and IFV/CFV) and large tube artillery weapons (M198, M110 and M109). Developed bioengineering technologies for assessment of protective helmets, seat systems and combat vehicle optical/lighting systems. Developed implantable transparent microwave electrodes for tissue temperature measurement. Completed studies of power density for various Army microwave systems (e.g., HAWK, NIKE, ROLAND, FIREFINDER). Conducted microwave studies of thermally induced cataracts and microwave induced performance disruption in animal models. Demonstrated significant permanent alterations in ocular functions due to argon laser exposures at levels below those allowed by current design standards. Conducted studies to characterize laser induced retinal injuries. Completed chemical characterization of hexachloroethane and red phosphorus (uncombustioned) smokes. Completed industrial toxicology studies of BZ and developed exposure criteria for safety standards in BZ demilitarization. Initiated research on propellant combustion products (i.e., carbon monoxide (CO), nitrous oxides (NO_x), sulphur dioxide (SO_2), and ammonia (NH_3) for development of troop exposure criteria. Began assessment of social interpersonal bonds which protect against combat psychiatric breakdown. Conducted studies of drug overdose in Europe. Conducted two field studies on jet-lag effects during long-range troop deployment to Europe. Evaluated human and laboratory model respiratory, musculoskeletal, motivational, pathophysiologic, pharmacologic and performance responses at high terrestrial altitude in animals and humans. Conducted assessment of bio-optical, psychomotor, physiologic, oculomotor and communication workloads during nap-of-the-earth (NOE) flight and other operational settings. Developed equipment and procedures for military occupational specialty (MOS) qualification profiling of physical fitness at induction stations (AFEES).

Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

2. (U) FY 1980 Program: Assess whole body inertial impact in combat vehicles and develop predictive models for impact injury. Conduct studies to determine mechanisms of hearing loss resulting from single noise bands and interaction between low frequency noise and vibration. Develop large animal model for field assessment of blast overpressure bioeffects during live firing of artillery cannons and blast tube simulation. Conduct human tests of actual hearing protection provided by current state-of-the-art protective devices. Continue development of advanced technologies for energy measurement in continuous microwave fields. Develop advanced technology for the study of mechanisms of injury underlying microwave induced cataracts. Begin millimeter wave ocular hazard assessment. Continue radar system hazard analysis. Recommend major revisions for safe human exposure levels to infrared and visible laser radiation. Continue Tri-Service laser bioeffects program and modify research objectives to support Navy, Marine and Coast Guard needs. Establish preliminary (eye/skin) safety recommendations for new military infrared laser wavelengths. Initiate subchronic mammalian toxicologic studies on fog oil, red phosphorus-butyl rubber and diesel fuel smokes in support of smokes/obscurants research. Conduct chemical characterization of the XM-1 tank crew compartment atmosphere. Initiate retrospective epidemiology study of munition plant workers. Determine relationship between unit activities (e.g., field exercises) and illness rates. Explore the relationship between stress and dysfunctional behavior in key personnel. Validate jet-lag field studies. Assess impact of drug use on interpersonal cohesion within military units. Complete a three-year epidemiologic study of psychiatric problems in female soldiers. Provide guidance to commanders on risks and prevention of heat/cold/altitude injuries. Develop medical data bases for assessment of extended helicopter operations and other operational requirements. Conduct trial implementation of AFEES physical fitness testing system.

3. (U) FY 1981 Planned Program: Develop night vision test assessment technologies. Continue studies on interactive effects of noise and vibration. Assess physiologic hazards of NBC (nuclear, biologic, chemical) protective clothing and equipment. Assess heat stress risk induced by combat vehicle crew clothing ensembles. Complete computer modeling of blast overpressure flow fields around artillery muzzles. Conduct cataract studies in intact animals exposed to microwave and millimeter wave radiation. Begin preproduction of electric field electrode and telemetry systems for measurement of continuous microwave fields. Complete specialized vision test program for military laser users. Provide early predictors of visual function recovery after laser exposure. Provide recommendations for laser eye protection. Initiate mammalian toxicologic evaluation of selected colored smokes. Conduct chemical characterization of rocket systems (CSRS) and artillery (M198). Initiate study to assess impact of marriage and military family responsibilities on unit cohesion. Continue study of stress effects on health. Determine interactive relationships between high terrestrial altitude and cold exposure. Develop biomedical criteria for crew selection/retention to develop performance and operational standards (e.g., visual, auditory, vibration, and pulmonary). Begin studies of training induced orthopedic injuries and preventive measures. Assess medical problems resulting from intense physical training in female soldiers. Personnel to be utilized: 196 professional and 238 support.

Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
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4. (U) FY 1982 Planned Program: Publish biomedical criteria for life support equipment design, whole body vibration and impact injury. Conduct acoustic, optical and vibration hazard field assessments. Assess the validity of existing military standards for impulse noise. Validate physical ear attenuation test methodology. Refine measures for microwave induced behavioral changes and exposure system comparison. Continue studies on mechanisms of injury from millimeter wave exposure. Evaluate rapidly responding multiwavelength laser protective devices. Expand data base on infrared and submillimeter laser eye and skin exposure for formulation of new safety recommendations. Complete mammalian toxicology of fog oil, red phosphorus-butyl rubber and diesel fuel smokes. Initiate toxicological evaluation of propellant combustion products unique to the tank (XM-1), rocket (GSRS) and artillery (M198). Characterize the physiologic costs of extended performance under stress. Examine the role of social support networks in preventing first term enlistment attrition. Define biologic/biochemical methods to improve soldier performance in the cold. Assess the performance impact of pharmacologic agents and hypohydration at high altitude. Refine measures of physical fitness for field use.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A878 Title: Health Hazards of Military Materiel
Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This is a restructured program. Combat requirements are driving development of new materiel technologies which may pose serious health hazards for the soldier. Health hazard assessment must be considered early in the design of emerging systems to ensure that human tolerances are not exceeded during their employment. The technical data base must be expanded to support the rational development of policy and directives which govern training and operational use of systems which are potentially hazardous to the user or which may degrade performance. Program emphasis is on exploratory development to: define physiological limits of individual human tolerance and biological impact of developmental and prototype military materiel systems and technologies; develop injury prevention and health protection criteria and technologies for use by health policymakers and materiel developers and testers; determine physiologic risk to immediate and long-term health relative to system generated health hazards. Research areas include: human tolerance and survivability factors related to auditory and systemic effects of impulse and steady-state noise, combat vehicle vibration/impact/crash-worthiness/life support equipment/clothing and crew stations, and micro-environmental heat and cold stress; health effects of electromagnetic radiation from laser use in weapons systems/rangefinders/designators/communicators/training devices, and microwave/millimeter wave use in communications and electronics, radar systems and training; toxic hazards of the military environment for troops exposed to combustion products/contaminants during field use of smokes/obscurants and weapons systems, and for Army industrial workers during manufacture and demilitarization of munitions.

B. (U) RELATED ACTIVITIES: This is a restructured program which was consolidated to best utilize existing technologies. Efforts for this project were previously funded under Program Elements/Projects: 6.27.71.A/A805, Microwave Injury; 6.27.72.A/A813, Health Effects of Military Lasers; 6.27.73.A/A819, Helicopter, Combat Crew and Airborne Medicine; 6.27.77.A/A845, Military Environmental Stress; and 6.27.77.A/A846, Toxic Hazards of Military Environments. Related Army research is performed under Program Elements/Projects 6.11.02.A/BS10, Research on Military Diseases, Injury and Health Hazards; and 6.27.77.A/A879, Medical Factors Limiting Soldier Effectiveness. Portions of the program directed at assessment of toxic chemical hazards are closely coordinated and complemented by Program Element/Project 6.11.02.A/BS04, Identification and Health Effects of Military Pollutants; and 6.27.20.A/A835, Environmental Quality Technology. 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. Army furnishes representatives to the tri-service Aerospace Research Program, Aerospace Standardization Coordinators Committee (tri-service plus English speaking nations), Helicopter Research Coordinating Panel (HRCP) and NATO's Advisory Group for Aerospace Research and Development to corduct collaborative efforts and minimize duplication. A

Project: #A878 Title: Health Hazards of Military Materiel
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memorandum of understanding between the US Army Medical Research and Development Command and the Human Engineering Laboratory ensures adequate medical/human factors input into the Army Systems Acquisition Review Council (ASARC)/Defense Systems Acquisition Review Council (DSARC). The 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 identified by all three services. To this end the three services emphasize the sharing of laboratory facility use whenever possible. Army maintains formal facility use agreement with the Bureau of Radiological Health, Environmental Protection Agency, and the Armed Forces Radiobiology Research Institute. In addition, Army maintains a program with DoD/Electromagnetic Compatibility Analysis Center to keep apprised of Army special utilization and operational system configurations.

C. (U) WORK PERFORMED BY: In-house research is conducted by the US Army Aeromedical Research Laboratory, Fort Rucker, AL; Letterman Army Institute of Research, Presidio of San Francisco, CA; Walter Reed Army Institute of Research, Washington, DC; US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD. The top five contractors include: Battelle Pacific North West Laboratories, Richland, WA; IIT Research Institute, Chicago, IL; Oak Ridge National Laboratories, Oak Ridge, TN; Arthur D. Little, Cambridge, MD; and Virginia Commonwealth University, Richmond, VA. There are 12 additional contractors at a cost of $812,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Developed models for assessment of steady-state noise, vibration and blast overpressure hazards related to new tracked armored vehicles (XM-1 and IFV/CFV) and large tube artillery weapons (M198, M110 and M109). Developed bioengineering criteria for helmets and protective seat systems. Developed criteria for transparencies and combat vehicle optical and lighting systems and for hearing loss from low frequency-high intensity noise. Established congruence of M198 overpressure wave and blast tube model to simulate artillery blast overpressure. Assessed vibration effects of visually coupled systems. Assessed interactive hazards of low frequency and high frequency noise exposures on hearing loss. Completed development and preproduction engineering of an advanced technology implantable transparent microwave electrode for tissue temperature measurement. Completed development of microwave transparent instrumentation for measurement of energy absorption in living tissue and for assessing cellular effects of microwave exposure. Completed studies of power density for various Army microwave systems (e.g., HAWK, NIKE, ROLAND, FIREFINDER) in order to determine health hazards to operating personnel. Conducted studies of microwave induced cataracts and microwave induced behavioral performance disruption in animal models. Demonstrated significant permanent alterations in ocular functions due to argon laser exposures at levels below those allowed by current design

Project: #A878 Title: Health Hazards of Military Materiel
Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

standards. Demonstrated subtle but persistent retinal changes caused by proposed gallium arsenide laser training devices. Developed data base for permissible cornea, retina and skin exposure to infrared lasers. Developed model for assessment of laser effects during tactical use of laser target designators and training devices. Characterized retinal sensitivity of primate model to existing and new military laser wavelengths. Conducted studies to characterize laser induced retinal lesions. Developed advanced ophthalmologic-photographic techniques for improved visualization of barely visible laser induced retinal lesions. Completed industrial toxicologic studies on BZ and developed exposure criteria for safety standards in BZ demilitarization. Initiated acute toxicologic research on fog oil, red phosphorus-butyl rubber, and diesel fuel smokes. Initiated research on propellant combustion products (i.e., carbon monoxide (CO), nitrous oxides (NO_x), sulphur dioxide (SO_2), and ammonia (NH_3)) to set exposure standards for troops operating weapon systems. Initiated feasibility study for epidemiology of munition plant workers.

2. (U) FY 1980 Program: Expand data base for combat vehicle vibration, physiological parameters of oxygen enrichment breathing systems, and biomedical criteria for new generation protective helmets and clothing. Investigate vibration effects on muscular control and fatigue. Assess whole body inertial impact in combat vehicles. Develop predictive models for mechanisms of impact injury (head and thorax). Conduct studies on effects of single noise bands on hearing loss, and interactive effects of low frequency noise and vibration. Expand visual assessment technologies for electro-optical systems and visionics. Develop large animal model for field assessment of blast overpressure bioeffects during live firing of artillery cannons and blast tube simulation. Conduct human tests of actual hearing protection provided by current state-of-the-art protective devices. Assess the potential for accidental injury to equipment operators/crews from climatic stress and fatigue precipitated by increased performance demands. Conduct non-invasive dosimetric studies of microwave energy absorption and dissipation in isolated animal organs. Continue development of advanced technologies for energy measurement in continuous microwave fields. Begin preproduction of a microwave transparent tissue-implant electrode. Develop advanced technology for the study of mechanisms of injury in microwave induced cataracts. Begin behavioral studies to compare microwave exposure systems and to assess detection of pulsed microwave fields with low average but high peak power. Begin millimeter wave ocular hazard assessment. Complete studies on cellular effects of microwave exposure. Continue radar system health hazard analysis. Recommend major revisions for safe human exposure levels to infrared and visible laser radiation. Complete laser target designator (LTD) and ground laser locator designator (GLLD) bioeffects coordinated test program. Continue tri-service laser bioeffects program and modify research objectives to support Navy, Marine and Coast Guard needs. Establish preliminary (eye/skin) safety recommendations for new military infrared wavelengths. Initiate subchronic mammalian toxicologic studies on fog oil, red phosphorus-butyl rubber, and diesel fuel smokes. Complete studies and recommend criteria for short-term high level troop exposure to CO, NO_x, SO_2 and NH_3. Conduct chemical characterization of the XM-1 tank crew compartment under various operating modes. Initiate retrospective epidemiology study of munition plant workers. Initiate problem definition study to determine research requirements for development of field water quality criteria.

Project: #A878 Title: Health Hazards of Military Materiel
Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

3. (U) FY 1981 Planned Program: Develop night vision test assessment technologies. Establish biomedical criteria for combat vehicle optics and transparencies. Conduct advanced attack helicopter (AAH) visual assessment. Continue studies on interactive effects of noise and vibration. Expand and integrate data base for noise hazards in armored vehicles. Establish mathematical models of whole-body impact injury. Assess physiological hazards of NBC (nuclear, biologic, chemical) protective clothing and equipment. Develop technology for dynamic assessment of oxygen supplementation during flight operations. Develop a large animal model for development of biomedical criteria in vibrating crew compartments. Publish medical criteria for thermal protective assessment of new fire protective clothing ensemble. Assess heat stress risk induced by combat vehicle crew clothing ensembles. Complete computer modeling of blast over pressure flow fields around artillery muzzles. Continue non-invasive dosimetric microwave analysis of isolated organs. Conduct studies of combined interactions between psychoactive drugs and microwave high peak power pulses and continuous wave radiation. Conduct cataract studies in intact animals exposed to microwave and millimeter wave radiation. Continue microwave behavioral detection studies and exposure system comparisons. Begin preproduction of electric field electrode and telemetry systems for measurement of continuous microwave fields. Complete specialized vision test program for military laser users. Validate revised limits for infrared laser exposure. Provide early predictors of human visual function recovery after laser exposure. Provide recommendations for laser eye protection. Continue subchronic mammalian toxicity testing of fog oil, red phosphorus-butyl rubber and diesel fuel smokes. Initiate mammalian toxicologic evaluation of selected colored smokes. Conduct chemical characterization of rocket systems (GSRS) and artillery (M198). Continue retrospective epidemiology of munition plant workers. Personnel to be utilized: 81 professional and 98 support.

4. (U) FY 1982 Planned Program: Develop improved technologies for assessment of vibration hazards. Publish biomedical criteria for life support equipment design, whole body vibration and impact injury. Conduct acoustic, optical and vibration hazard field assessments. Develop animal models for impact injury. Conduct hazard assessment of new combat vehicle crewman clothing system. Validate physical ear attenuation test methodology. Assess the validity of existing military standards for impulse noise. Investigate non-auditory injury resulting from repeated exposures to blast overpressure. Continue non-invasive dosimetric microwave studies. Continue studies on mechanisms of injury from millimeter wave exposure. Refine measures for microwave induced behavioral changes and exposure system comparison. Begin studies on combined effects of infectious disease and exposure to radio-frequency, microwave and millimeter wave radiation. Begin microwave telemetry development for high peak power fields studies. Conclude microwave blood-brain-barrier studies. Evaluate rapidly responding multiwavelength laser protective devices. Expand data base on infrared and submillimeter laser eye and skin exposure for formulation of new safety recommendations. Complete mammalian toxicity tests on fog oil, red phosphorus-butyl rubber and diesel fuel smokes. Continue toxicologic evaluation of colored smokes. Initiate toxicologic evaluation of propellant combustion products unique to the tank (XM-1), rocket (GSRS)

Project: #A878 Title: Health Hazards of Military Materiel
Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

and artillery (M198). Complete retrospective epidemiology of munition plant workers. Conduct problem definition studies on new smokes/obscurants, propellants and high explosives.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable.

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	3654	9430	6586	6881	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	3652*	9912*	19402*	-	Continuing	Not Applicable

*Funds were shown on the FY 1980 submission under Program Elements/Projects: 6.27.71.A/A805 ($2092); 6.27.72.A/A813 ($1492); 6.27.73.A/A819 ($1635); 6.27.77.A/A845 ($900); and 6.27.77.A/A846 ($3793) for FY 1980. FY 1981 estimates as shown on the previous submission were $3775, $3722, $2655, $948, and $8302, respectively.

The decrease in FY 1980 current requirements, compared to the previously submitted estimate, is the result of a Congressional reduction in 6.27.72.A/A813, Health Effects of Military Lasers. The decrease in the FY 1981 estimate represents a reduced level of effort resulting from budgetary decisions which have led to deferral of anticipated new starts in FY 1981.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A879 Title: Medical Factors Limiting Soldier Effectiveness
Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This is a restructured program. Technology and doctrine trends permit clear prediction that the battlefield of the future will be characterized by an intensity, ferocity and fluidity of combat never before experienced. Heightened physical, mental and psychological demands will be imposed by possible or actual exposure to lethal and incapacitating weapons systems; complex performance requirements associated with advanced weapons systems and doctrine; engagement in high intensity continuous/sustained operations in open terrain or built-up areas; and performance degradation due to rapid transmeridian troop deployment. New health threats and combinations of stressors with unique and compounded hazards reduce overall system effectiveness and make the soldier the weak link. This program is directed toward exploratory development of medical factors limiting soldier effectiveness in order to assess soldiers' physical/physiological/psychological capabilities to function effectively under environmental and operational stress; and prevent adverse effects of stress on health, safety and performance by means of selection criteria, protective equipment and operational measures. Emphasis is placed on: (1) neuro-psychiatric factors resulting from continuous/sustained high intensity conflict, rapid mobility deployment and jet-lag; military unique drug and alcohol abuse medical research requirements; and psychosocial factors relating to first term enlistment attrition and female soldier maladjustment; (2) combat crew performance enhancement factors related to the impact of environmental extremes on performance and enhanced physiologic/psychologic acclimatization to heat, cold and altitude; development of task performance measures, workload criteria and physiologic/psychologic indices of aviator alertness/fatigue; and assessment of visual problems involved in integrating man with electro-optical systems, heads-up displays, complex weapons systems, and night operations; (3) physical fitness and selection factors involving development of physical fitness standards for sedentary and physically demanding military occupational specialties; validation and refinement of physical fitness standards for all military occupational specialties; and establishment of Army aircrew selection, retention and physical performance criteria.

B. (U) RELATED ACTIVITIES: This is a restructured program which was consolidated to best utilize existing technologies. Efforts for this Project were previously funded under Program Elements/Projects 6.27.71.A/A804, Military Psychiatry; 6.27.73.A/A819, Helicopter, Combat Crew and Airborne Medicine; and 6.27.77.A/A845, Military Environmental Stress. Related Army research is performed under Program Elements/Projects 6.11.02.A/BS10, Research on Military Diseases, Injury and Health Hazards; and 6.27.77.A/A870, Health Hazards of Military Materiel. The Army furnishes representatives to the Department of Defense Drug and Alcohol Abuse Research and Development Liaison Group. This Liaison Group interacts with the National Institutes of Health's Alcohol Drug Abuse and Mental Health Administration (ADAMHA) which oversees the activities of the National Institute on Drug Abuse (NIDA) and National Institute on Alcohol Abuse and Alcoholism (NIAAA). This Group provided NIDA with a breakdown of proposed drug and alcohol

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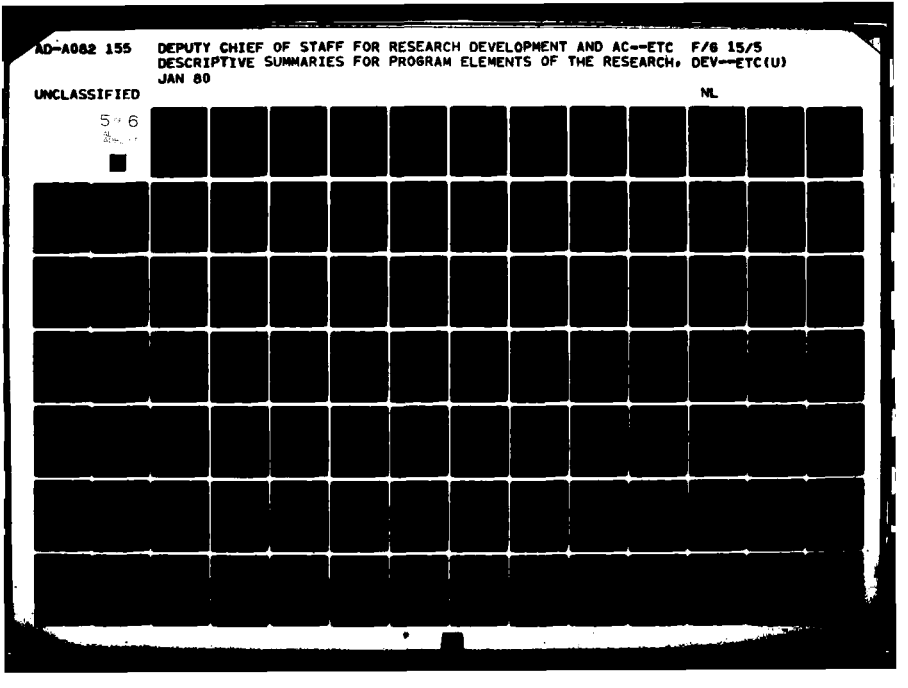

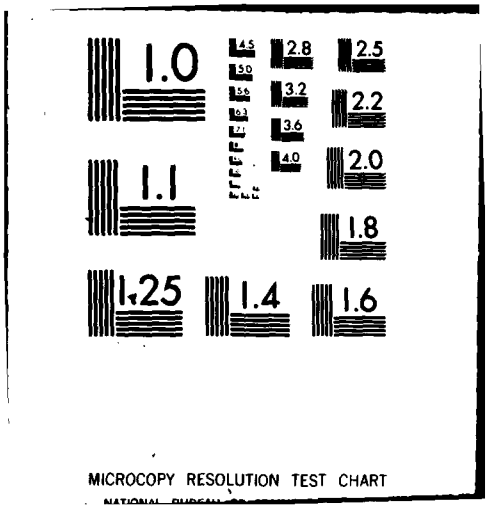
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Project: #A879 Title: Medical Factors Limiting Soldier Effectiveness
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DoD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

abuse research projects of interest to DoD. In addition, an Army representative attends the NIDA/NIAAA Study Sections to keep abreast and assess areas of interest which have potential military applications. Representatives are also furnished to the Department of Defense Drug and Alcohol Abuse Advisory Committee, whose purpose is to coordinate tri-service activities in order to avoid duplication of effort. An extensive network of formal and informal relationships with other government 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. The environmental medicine research program maintains extensive coordination of both formal and informal nature with Navy, Air Force, Marine Corps and NASA, in order to conduct collaborative projects and minimize duplication of effort.

C. (U) WORK PERFORMED BY: In-house research is conducted by the Walter Reed Army Institute of Research, Washington, DC; US Army Aeromedical Research Laboratory, Fort Rucker, AL; and US Army Research Institute of Environmental Medicine, Natick, MA. The top five contractors include: Associate Consultants, Inc., Washington, DC; University of California, La Jolla, CA; Optical Science Group, Inc., San Rafael, CA; Ketron, Inc., Arlington, VA; and Baylor College of Medicine, Houston, TX. There is one additional contractor at a cost of $40,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Assessed the strength of social bonds which protect soldiers from breakdown in combat. Assessed female soldier health problems which indicated twice the rate of psychiatric hospitalization as that of males. Explored the difficulties in achieving group membership encountered by basic trainees and administratively discharged soldiers. Conducted studies of drug overdose in Europe which pointed to a lack of concern of soldiers for another's welfare and raised doubts about existence of required cohesion for combat. Conducted two field studies on long-range troop deployment to Europe which indicated that the physiologic and performance disruption produced by jet-lag could be partially offset by preventive measures aboard the aircraft. Psychological factors and physical performance capacity were also assessed during these deployment exercises. Evaluated respiratory, musculoskeletal, motivational, pathophysiologic, pharmacologic and performance responses at high terrestrial altitude in laboratory animals and humans. Conducted multiservice international conference on "Problems of Medical Evacuation in Cold Weather" to outline major problem areas. Developed biomedical criteria and data collection methodology and conducted measurements of bio-optical, psychomotor, physiologic, oculomotor and communication workloads during nap-of-the-earth (NOE) flight, aviation self deployment, crew station compatibility and unaided vision/night vision goggle compatibility. Designed and developed combat spectacles. Developed and evaluated equipment/procedures for physical fitness military occupational specialty (MOS) qualification profiling at AFEES. Completed initial development of gender free physical fitness standards for all Army MOS's.

Project: #A879 Title: Medical Factors Limiting Soldier Effectiveness
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2. (U) FY 1980 Program: Continue studies on role of interpersonal bonds in protecting against dysfunctional behavior and psychiatric breakdown. Determine relationship between unit activities (e.g., field exercises) and illness rates. Determine how stress contributes to dysfunctional behavior and illness in key personnel (e.g., drill sergeants). Conduct physiologic monitoring of personnel in high stress jobs (e.g., fire fighters, rescue workers) to better characterize physiologic changes produced by life threatening stress in natural settings. Validate jet-lag field study findings and measures to counteract jet-lag, in the laboratory. Assess impact of drug use on interpersonal cohesion (a key variable of combat readiness) within military units. Complete a three-year epidemiologic study of psychiatric problems in female soldiers. Conduct a study of combined stressors with field artillery units. Assess the effectiveness of spironolactone in prevention of acute mountain sickness. Provide guidance to commanders on risks and prevention of heat/cold/altitude injuries to improve troop performance. Quantify the decremental effects of psychotropic drugs and low grade fever on the ability to work in the heat. Evaluate the use of infrared thermography in the diagnosis of cold injury. Develop medical data bases for assessment of extended helicopter operations (instrument flight profiles, surge operations, day/night terrain), human performance capabilities/tolerance limits in manned systems, operational impact of stress/fatigue, integrated night vision goggle (NVG) and other optical displays, combined effects of vibration/noise/optical stress, prolonged contact lens wear, and physiologic impact of supplemental oxygen on aviator performance. Conduct trial implementation of AFEES Physical Fitness Testing System. Complete determination of new MOS-based gender free physical fitness standards.

3. (U) FY 1981 Planned Program: Initiate field study to determine causes of excessive female soldier illness rates. Conduct field validation of countermeasures to offset jet-lag effects. Initiate study to assess impact of marriage and military family responsibilities on unit cohesion. Continue studies of stress effects on health. Determine interactive relationships between high terrestrial altitude and cold exposure. Compare male/female physiologic responses to high-altitude hypoxia and susceptibility to acute mountain sickness. Evaluate substances to prevent frostbite of feet in cold climates. Determine manual performance decrements of keyboard operators in the cold. Develop biomedical criteria for crew selection/retention to develop performance and operational standards (e.g., visual, auditory, vibration, pulmonary). Develop technology for assessment of general and visual workload and stress parameters in crew members/attack helicopter pilots during routine and sustained operations. Begin studies of training induced orthopedic injuries and preventive measures. Assess medical problems resulting from intense physical training in female soldiers. Personnel to be utilized: 115 professional and 140 support.

4. (U) FY 1982 Planned Program: Validate field studies of female soldier health problems. Characterize the physiologic costs of extended performance under stress. Examine the role of social support networks in preventing first term enlistment attrition. Expand epidemiologic studies of peacetime psychiatric dysfunction to characterize risk factors for predicting

Project: #A879 Title: Medical Factors Limiting Soldier Effectiveness
Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
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breakdown in combat. Define biologic/biochemical methods to improve soldier performance in the cold. Assess the performance impact of pharmacologic agents and hypohydration at high altitude. Assess the impact of dehydration on peripheral temperature regulation and performance in the cold. Refine biomedical technologies and medical criteria to develop health standards, improve engineering design of combat systems and operations, and to assess the impact of new weapons systems and protective clothing on soldier effectiveness. Refine measures of physical fitness for field use.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable.

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimates Cost
RDTE						
Funds (current requirements)	4424	5571	6672	6980	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	4476*	6141*	8898*	-	Continuing	Not Applicable

*Funds were shown on the FY 1980 submission under Program Elements/Projects 6.27.71.A/A804 ($2964), 6.27.73.A/A819 ($1280), and 6.27.77.A/A845 ($1897) for FY 1980. FY 1981 estimates as shown on previous submission for those efforts were $5223, $1676, and $1999, respectively. The decrease in FY 1979 resulted from adjustments made near the end of the fiscal year to make maximum utilization of available funds.

The decrease in FY 1980 current requirements, compared to previously submitted estimate, is the result of a Congressional reduction in 6.27.71.A/A804, Military Psychiatry. The decrease in the FY 1981 estimate represents a reduced level of effort resulting from budgetary decisions which have led to deferral of anticipated new starts in FY 1981.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.81.A
DOD Mission Area: #523 Engineering Technology (ED)

Title: Energy Technology Applied to Military Facilities
Budget Activity: #1 -Technology Base

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL PROGRAM ELEMENT	0	0	1607	1614	Continuing	Not Applicable
AT45	Military Energy Technology	0	0	1600	1600	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program is oriented to develop tools and techniques to effectively apply new energy systems technology developed by the Department of Energy and the civil sector to Army installations in order to reduce energy consumption in existing Army facilities by 20 percent and in new facilities by 45 percent by 1985 in compliance with the President's energy goals. The program focus is to develop guidance and criteria for the selection of the most effective energy conservation measures from among the countless choices available, to examine the potential of alternate energy sources to replace fossil fuels when unique installation scale applications are appropriate, to increase energy independence and management of energy resources on Army installations, and to minimize the effect of energy shortages and high costs. Resources saved by reducing facility energy costs can be used to support Army training and combat readiness.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: This program is an essential element of the Army program to conserve energy in a significant way. First, energy use must be characterized, and then methods and systems must be adopted or developed to reduce energy use on Army installations. An evaluation of alternate fuels is also essential to supplement or replace high-cost fossil fuels. Research in energy conservation will develop tools to adapt technology developed by others to Army needs or develop the necessary technology which is unique to Army operations. These tools are essential for (1) rational formulation of future energy goals; (2) analysis and evaluation of alternative strategies for the Army's energy conservation investment programs; and (3) estabishing priorities for existing facility retrofits and proposed new construction to meet current energy consumption goals. Research in alternative energy sources will be directed to: (1) solar energy applications as mandated by Congress for the Military Construction Program; (2) the evaluation of waste-derived and biomass-derived fuels to take advantage of fuel sources on Army installations; and (3) the use of coal technology as a primary energy source at military facilities to permit conversion from oil and gas as primary fuels in central energy plants. The major objectives include: (1) the establishement of standards for energy use in facilities and installations; (2) the development of performance and acceptance criteria to permit the evaluation and procurement of solar energy heating and cooling systems; (3) systems and

Program Element: #6.27.81.A
DOD Mission Area: #523 Engineering Technology (ED)

Title: Energy Technology Applied to Military Facilities
Budget Activity: #1 -Technology Base

procedures for the use of waste derived fuel and bio-mass derived fuel; and (4) criteria and techniques for cost-effective conversion to coal as a primary energy source on military installations.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
RDTE						
Funds (Current Requirements)	0	0	1607	1614	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	0	2635	2716	2296	Continuing	Not Applicable

FY 1980 project funding of $2.6 million was deleted from Military Appropriations Bill by Joint Appropriations Committee action in the 96th Congress. Decrease in FY 1981 and FY 1982 funds reflects intent of Congress to obtain required technology from the Department of Energy.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.81.A
DOD Mission Area: #523 Engineering Technology (ED)

Title: Energy Technology Applied to Military Facilities
Budget Activity: #1 -Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This research addresses the reduction of military facilities energy consumption and minimization of the impact on Army operations because of the increasing cost of petroleum fuel. The prime thrust is to develop tools to evaluate technology being developed by the Department of Energy and the civilian sector to permit adaptation of the applicable technology to Army use. The thrust includes development of analytical methods and management techniques to provide facility engineers, installation commanders, and the Department of the Army with the techniques and methods to assess energy alternatives and develop long-range plans for energy management and fuel sources compatible with the Army mission.

G. (U) RELATED ACTIVITIES: The energy technology program was formerly a technical area in Program Element 6.27.31.A, Energy Technology Applied to Military Facilities, Project AT41, Military Facilities Engineering Technology. This program is coordinated on an inter-service basis with both Navy and Air Force through the activities of the Inter-Agency Power Group, Joint Services Civil Engineering Research and Development Coordinating Group, and the Tri-Service Energy Control System Specification Working Group. Joint programs with the Air Force include the Energy Audit Program and development of the Building Loads Analysis and Systems Thermodynamics (BLAST) Program. Related Projects are: Project AT23 - Basic Research in Military Construction, US Army Engineer Construction Engineering Research Laboratory, Champaign, IL; AT41 - Military Facilities Engineering Technology, US Army Engineer Construction Engineering Research Laboratory, Champaign, IL; and Project A896, Environmental Quality Technology - US Army Engineer Construction Engineering Research Laboratory, Champaign, IL. In cooperation with the Department of Energy, the US Army has been assigned lead responsibility for coordinating DOD energy activities in solar heating and cooling, computer programs to determine energy characteristics of buildings, wood-fired boilers, energy storage and distribution, energy conservation, and advanced heating and air conditioning systems.

H. (U) WORK PERFORMED BY: Approximately 65 percent of project funds will be used for in-house effort at the US Army Engineer Construction Engineering Research Laboratory with participation by the US Army Facility Engineer Support Agency, Ft. Belvoir, VA, and the US Army Cold Regions Research and Engineering Laboratory, Hanover, NH.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishment: Not Applicable.

2. (U) FY 1980 Program: Not Applicable.

3. (U) FY 1981 Planned Program: The planned research in the Energy Conservation and Alternate Source Technology technical area includes: (1) analysis of potential application of the commercial development of various coal technologies to Army installations; (2) updating the Army Solar Design Manual to reflect lessons learned and incorporating new solar technologies; (3) development of performance acceptance testing procedures for installation-scale modular heat recovery incinerator systems; (4) development of criteria for handling and storing refuse-derived fuel at installation-scale facilities; (5) evaluating current coal handling equipment for application to use of coal at military installations; and (6) development of techniques to accomplish economic comparisons during early design and review stages for energy conservation

design trade-off decisions. Research planned in the Energy Management and Control Technology technical area includes development of: (1) procurment specifications to obtain required test and calibration instruments for field calibration of heating, ventilating, and air conditioning systems in Army buildings; (2) predictive models for the Energy Consumption Reporting and Analysis System; and (3) interactive input language for more simplified use of the Building Loads Analysis and Systems Thermodynamics (BLAST) Program. The FY 81 research program will involve 26 professional and 12 support personnel for the in-house effort and contract monitoring.

4. (U) FY 1982 Planned Program: Currently scheduled research in the Energy Conservation and Alternate Source Technology technical area includes: (1) assessment of commercial use forecasts on solar, bio-mass, waste-derived fuel, and geothermal alternate fuel sources; (2) operation and maintenance procedures for solar heating and cooling systems; (3) engineering instructions for refuse-derived fuel production, handling, combustion, and bi-product disposal; (4) procedures for specifying procurement, plant design and acceptance testing of modular heat recovery incinerator systems; (5) specifications for the design of advanced installation scale coal conversion systems for military facilities; and (6) methods to make passive energy design cost trade-off decisions during early design stages to reduce energy consumption in planned facilities construction. Currently scheduled research in the Energy Management and Control Technology technical area includes: (1) performance specifications and prototype instrumentation for the performance measurements and calibration of thermal energy sources and systems; and (2) preparation of technology transfer documentation and transfer of the Energy Consumption Reporting and Analysis System to the facilities engineers.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.31.02.A
Title: Materials Scale-Up
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2078	3300	3034	6598	Continuing	Not Applicable
D071	Materials Scale-Up/Structures Demonstration	2078	3300	3034	6598	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The work under this program is non-system 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 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 increasingly demanding requirements of advanced weapon systems with resultant costly overdesign, costly and sometimes castastrophic 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 absence of the necessary performance 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 antiarmor munitions; and high maintenance/operations costs of advanced helicopter drive-train systems components due to unavailability of demonstrated high modulus - lightweight materials.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Programs will be continued to scale-up, evaluate and fully demonstrate the performance, reliability, maintainability, and cost effectiveness or improved hear, bearing, drive shaft, and transmission reinforcement materials for advanced Army helicopter drive-train systems and of powdered metals compositions and alloys for cores of

Program Element: #6.31.02.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Materials Scale-Up
Budget Activity: #2 - Advanced Technology Development

advanced high-density penetrator munitions. Programs will also be continued to evaluate and demonstrate effectiveness of scaled-up composite components for portable lightweight bridging and of spall suppression liner materials combinations for ground combat vehicles. A program will be initiated to fabricate, evaluate and demonstrate advanced-concept vehicular armor sections to defeat penetrator munitions.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	2078	3300	3034	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	2026	3300	6450	Continuing	Not Applicable

The FY 1979 funding increase above the FY 1980 submission was applied to offset, in part, the reduction in level of program effort due to inflation. The FY 1981 decrease in the current submission resulted from the need to apply funds to higher priority programs.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.31.02.A Title: Materials Scale-Up
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Knowledge is being continually produced through exploratory development of 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 material in engineering development of Army weapon systems. This program, designed to fill that gap, was initiated 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 production from advanced materials to minimize scaled-up surprises; and to demonstrate cost effectiveness of advanced materials hardware to minimize cost overruns. Deficiency in knowledge of scaling factors of superior high strength properties of metal-matrix composites prevents near-term application in advanced Army weapon systems.

G. (U) RELATED ACTIVITIES: The Air Force, Navy, and 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 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. Through coordination precludes duplication of effort.

H. (U) WORK PERFORMED BY: In FY 1981, it is planned that approximately 60 percent of the work will be accomplished in-house at the US Army Materials and Mechanics Research Center, Watertown, MA; US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA; and the Army Armament Research and Development Command, Dover, NJ; and the Army Aviation Research and Development Belvoir, VA; and the Army Aviation Research and Development Command, Fort Eustis, VA. Typical contractors are AVCO, Lowell, MA; Battelle-Columbus, Columbus, OH; Lockheed Aircraft Corporation, Sunnyvale, CA; and NETCO, Long Beach, CA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Lightweight, high strength structural foam components have been fabricated and scaled-up for low-cost ammunition pallets, tank track shoes, and for the stabilization element of remotely piloted vehicles. Specifications were determined for core materials composition and for processing and fabrication procedures in the scaled-up state for high-density penetrator munitions. Current portable bridging structures have span length and stiffness limitations imposed by the load capability of the transport/retrieval vehicle. Work was carried out to scale-up and stiffen reinforced

plastic structures thereby increasing span length without increasing weight. Scaled-up bridge members and attachment components were designed and fabricated by the pultrusion processing method. Severe behind-the-armor effects within combat vehicles caused by impact by kinetic energy and other projectiles generate increased casualties and damage to critical components. To protect against this damage, subscale composite spall suppression liners were fabricated and evaluated. Subscale CH-47 transmission housings reinforcements of aluminum-aluminum oxide fibers were sucessfully fabricated for the first time in efforts to rebuce drastically the time between over or helicopter transmissions.

2. (U) FY 1980 Program: Full-scale lightweight composite bridging components will be fabricated and evaluated. Full-scale testing will be initiated on metal-matrix composite helicopter transmission housing components by installing in the aircraft and performing ground tests. A major scale-up armor materials development program will be initiated in innovative approaches, including advanced 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. Work will be initiated on scale-up and evaluation of erosion-resistant linings and coatings for large caliber gun tubes. New concepts for the bottom chord of the mobile assault bridge will be developed exploiting advanced composite reinforcements. Test sections will be fabricated.

3. (U) FY 1981 Planned Program: Tasks initiated in FY 1979 and FY 1980 will be continued. Work will be conducted to scale-up, evaluate, and demonstrate performance of metal-matrix composite materials for Army helicopter drive train systems. Program will be expanded to fabricate and evaluate advanced materials and approaches to provide vehicular armor to defeat penetrator munitions. Work will continue on advanced penetrator materials with emphasis on processing technique for scaled-up test samples. Work will be carried out to produce high quality tungsten bars 1 1/2 inches in diameter for fabrication or penetrator test cores. Scaled-up penetrators will be test fined and mechanically tested.

4. (U) FY 1982 Planned Program: Tasks initiated in FY 1980 and FY 1981 will be continued. Full-scale prototype, metal-matrix composite mobile bridges components will be fabricated. A new major task will be initiated to scale-up, evaluate and demonstrate high strength-lightweight composite materials for use in a family of lightweight Army ground vehicles.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.31.04.A Title: Fuels and Equipment
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	2000	1018	2279	Continuing	Not Applicable
D150	Fuels and Equipment	0	2000	1018	2279	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army's Research, Development, Test and Evaluation (RDTE) program has been lacking in an adequate capability to conduct Advanced Development of component subsystem necessary for use of new fuels and lubricants and capability to execute field/user evaluation and testing prior to issuing new products. The purpose of this program is to conduct the necessary Advanced Development for new fuels, fluids and subsystems, and to conduct field user evaluation to verify the acceptability of these fuels and lubricants for use in military vehicles and other items of materiel.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Initiate Advanced Development and evaluation of low vulnerability fuels that will significantly increase survivability of ground combat vehicles encountering fuel system fires. Initiate Advanced Development of a total system for mixing, handling and storage of low vulnerability fuels for use in combat environments. Plan and initiate advanced qualification testing/evaluation of synthetic mobility fuels for use in Army vehicles and equipment.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands):

	FY 1979	FY 1980	FY1981	Additional To Completion	Total Estimated
RDTE					
Funds (Current requirements)	0	2000	1018	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	0	600	1580	Continuing	Not Applicable

The increase in the 1980 funding is to provide support for additional work to qualify synthethic mobility fuels for Army vehicles.

Program Element: #6.31.04.A Title: Fuels and Equipment
DOD Mission Area: #553 - Engineering Technolgy (ATD) Budget Activity: #2 - Advanced Technology Development

The decrease in the FY 1981 planned funding as shown in the FY 1981 submission below that in the FY 1980 submission is due to the requirement to provide support for higher priority programs.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.31.04.A Title: Fuels and Equipment
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program covers those efforts directed towards overcoming obstacles to mobility and increased survivability of ground combat vehicles caused by present low probability of survivability of crews and costly damage to vehicles beyond the point of salvage due to fuel system fires of ground combat vehicles. Multiple lethal effects of intense heat, exploding ammunition and disabling atmospheric environment are the threats that must be overcome. The objective of this project is to develop a Low-Vulnerability Fire-Safe Fuel that will significantly increase the survivability of combat vehicles. The approach taken is to optimize an emulsion of diesel fuel, water, emulsifiers, and antimist additives to achieve the required properties. Laboratory and fleet tests will be performed to insure compatibility with the appropriate Army ground combat vehicles. A field mixing unit and modified pumping/filtration equipment will be developed to prepare and handle the fuel. The program will also include the planning and execution of the advanced testing and qualification of synthetic mobility fuels for army vehicles and equipment.

G. (U) 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 the Department of Energy.

H. (U) WORK PERFORMED BY: In-house work by US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA, and the US Army Fuels and Lubricants Research Laboratory, Southwest Research Institute, San Antonio, TX.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Not Applicable. New start in FY 1980.

2. (U) FY 1980 Program: Conduct Advanced Development and evaluation of low-vulnerability fuels that will significantly increase survivability of ground combat vehicles to fuel systems fires. Initiate Advanced Development of total system for mixing, handling and storage for low-vulnerability fuels for use in combat environments. Initiate advanced testing of the effects on performance of the use of gasohol in Army vehicles and equipment. Initiate planning and execution of advanced qualification testing/evaluation of shale oil mobility fuels in Army vehicles. There will be 15 professionals and 18 support personnel involved in these efforts.

3. (U) FY 1981 Planned Program: Conduct extensive field tests with Fire Resistant fuels including supporting equipment used in field operations. Complete user acceptance testing with the candidate corrosion-inhibited turbine engine oil, conduct full-scale engine and fleet tests using the engine oil and fuel quality monitors, conduct engine testing with the candidate high energy fuel, initiate fabrication of the anti-freeze condition system and conduct field evaluation on use of crude oil as a field emergency fuel. Army vehicles must possess the capability to safely use future synthetic fuels and blends of such

Program Element: #6.31.04.A Title: Fuels and Equipment
DOD Mission Area: #553 - Engineering Technolgy (ATD) Budget Activity: #2 - Advanced Technology Development

fuels which will become a part of the nation's fuel supply. The advanced field testing and evaluation of the effects of such fuels on Army engines will be conducted in this program. Complete field testing of gasohol in Army vehicles. Conduct initial exploratory fielded test of shale oil mobility fuels in selected Army ground vehicles. There will be 10 professionals and 5 support personnel involved in these efforts.

4. (U) FY 1982 Planned Program: Continue to conduct fleet test of mixed vehicles, and determine effects of fire-safe fuels on engine performance and durability. Procure field mixing units for tests and evaluation. Prepare sufficient quantities of fire-safe fuels to establish quality assurance requirements and investigate extent of field testing required for these fuels. Procure for tests and evaluation filters and pumps needed for transfer and dispensing fire-safe fuels for vehicle fleet testing. Begin field test and plan fleet tests of shale oil mobility fuels for a broad spectrum of Army vehicles. There will be 21 professionals and 27 support personnel involved in these efforts.

5. (U) Program to Completion: This is a continuing program with progressively planned goals to: convert to JP-8, introduce alcohol-gasoline blends, develop a high-sulphur diesel fuel capability, introduce fire-safe fuel, introduce high-energy fire-safe fuel, use crude oil as field emergency fuel, introduce products from crudes blended with 5% shale syncrude, introduce products from crudes blended with 10% shale syncrude, make 10% shale-derived products available for DOD, introduce 10% syn-fuel from coal, and introduce solid fuels.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.01.A
Title: Aircraft Power Plants and Propulsion
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7000	8282	4657	18447	Continuing	Not Applicable
DB72	Propulsion Components	0	0	308	4557	Continuing	Not Applicable
D447	Demonstrator Engines	7000	8282	4349	13890	Continuing	Not Applicable

B. (U) 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 confirmatory tests of engines and transmissions. This advanced engine and transmission technology is available for use in advanced airmobility systems and provides for reductions in fuel consumption, weight, maintenance requirements, vulnerable areas, production cost, and reductions in leadtime for future developmental hardware.

C. (U) BASIS FOR FY 1981 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. Testing will be completed in FY 1981, and final reports will be provided to validate technology improvements. Expectations are to provide 20 percent reduction in fuel consumption, 50 percent reduction in vulnerable areas, and 25 to 35 percent increase in specific horsepower (SHP per pound of airflow). These advance technology demonstrator engines are being valued as potential core engine candidates for emerging aircraft systems such as ASH.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsio
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	7000	8282	4657	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	7000	8300	6085	Continuing	Not Applicable

Reduction in FY 1981 funds is due to funds being shifted to higher priority work. Difference in FY 1980 funds is due to a general Congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsion
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) 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 full-scale 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 industry-sponsored programs are applied to advanced gas generators, engines, and drive trains in demonstration and validation tests. Primary emphasis is placed on those areas that will benefit near-term aircraft development programs. D447: Complete engine subsystems are integrated and tested under the Advanced Technology Demonstrator Engine (ATDE) program. DC72: The Helicopter Advanced Drive Train (HADT) program provides the systems approach for a multidisciplinary effort and places drive train technology on a par with the many advances made in aircraft turbine engines.

G. (U) 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 semiannual 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.A, Air Mobility; 6.22.09.A, Aeronautical Technology; and 6.42.06.A, Utility Tactical Transport Aircraft System (T700 Engine Project; 6.22.03.F, Aerospace Propulsion; 6.32.06.F, Advanced Turbine Engine Gas Generator; 6.32.02.F, Advanced Propulsion Subsystems Integration; 6.32.10.N, Advanced Aircraft Propulsion.

H. (U) WORK PERFORMED BY: Detroit Diesel Allison Division, General Motors Corporation, Indianapolis, IN; and AVCO Lycoming Division, Stratford, CT. The program is the responsibility of the Applied Technology Laboratory of the US Army Research and Technology Laboratories, US Army Aviation Research and Development Command, Fort Eustis, VA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Historically, 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

Program Element: #6.32.01.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Aircraft Power Plants and Propulsio
Budget Activity: #2 - Advanced Technology Development

can be realized through technology verification in an engine of approximately 800 shaft horsepower (SHP). The technology demonstrated in this program provides the basis and opportunity to move into an engineering development program for future applications including current inventory aircraft derivatives. 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), CH47D helicopter, and the Navy's SH-60B in helicopter; (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 1978, the Advanced Transmission Component program resulted in: (1) manufacturing of high contact ratio test gears; (2) advanced design thrust carrying cylindrical roller bearing was fabricated and tested for over 200 hours; (3) completed design of modified tapered roller bearing; (4) completed fabrication of magnetic seals; and (5) defined heat treatment required for new X-53 gear material.

2. (U) FY 1980 Program: Continue the 800 shaft horsepower Advanced Technology Demonstrator Engine program with the two selected contractors, AVCO Lycoming and Detroit Diesel Allison (DDA). Program goals remain to demonstrate significant improvements in engine performance (reduction of specific fuel consumption by 20 percent and increase in specific horsepower of 25 to 35 percent) with improvements in reliability, maintainability, and survivability characteristics compared to current engines in this class, while offering potential for a substantial reduction in production cost. Each 800 SHP Advanced Technology Demonstrator Engine contractor will complete development testing and initiate final demonstration testing. Full engine testing will be initiated in FY 1980.

3. (U) FY 1981 Planned Program: Each 800 horsepower ATDE contractor will complete all demonstration testing and submit final technical reports. A Fuel Efficient Engine (FEE) program will be initiated for the 4000-5000 shaft horsepower size class to validate achievable levels of performance and mechanical integrity of configurations which will allow fuel consumption improvements of 20 to 25 percent for the medium lift helicopter/engine combination. For this concept, two programs will be initiated to validate results from successful exploratory development components efforts in a real engine environment: (1) thermal control turbine shrouds for enhanced engine performance (up to 5 percent in both specific power and specific fuel consumption) at no increase in engine cost; (2) cooled radial turbine that has the potential of 5 percent performance improvement and cost reduction over cooled axial turbines. A program will be initiated to evaluate erosion resistant compressor coatings in a sand and dust environment. For DB72: A program to demonstrate the use of a spring-type, advanced, overrunning clutch promises reduced weight, cost, and improved reliability over existing clutches. A lightweight drive system program to achieve weight reductions of up to 20 percent, cost reductions of up to 25 percent, and reliability improvements of 20 to 50 percent will be initiated.

Program Element: #6.32.01.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Aircraft Power Plants and Propulsion
Budget Activity: #2 - Advanced Technology Development

4. (U) FY 1982 Planned Program: D447: Continue the fuel efficient program. Major efforts will focus on thermal control turbine shrouds and air cooled radial turbines. In FY 1892 a program will be initiated to demonstrate a convertible fan/shaft T-700 core engine to provide both main rotor power and auxiliary thrust for high speed flight. DB72: Complete program initiated in FY 1981. Initiate a technology demonstration of lightweight, high speed clutch for BLACKHAWK (UH-60) and Advanced Attack Helicopter (AH-64) with goal of producing a weight deduction of 36 pounds.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.32.06.A
Title: Aircraft Weapons
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	470	6466	19360	Continuing	Not Applicable
D043	Aircraft Weapons Fire Control	0	470	2985	14134	Continuing	Not Applicable
D044	Aircraft Gun-Type Weapons	0	0	0	1307	Continuing	Not Applicable
D039	Mast-Mounted Sight Technology	0	0	3481	0	0	3481
D318	Air Self-Defense System	0	0	0	3919	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports the advanced development and testing of new aircraft weapon subsystems to improve the capability of aircraft weapon systems under conditions of Day/Night adverse weather. New concepts in target acquisition and fire control will be developed to improve system accuracy, terminal effects, airframe compatibility, and overall system reliability. Currently planned and available systems do not have adverse visibility capability and are limited in range. Program objective will be accomplished through the design, fabrication, and testing of advanced development experimental hardware of fire control devices for aircraft weapon systems on attack and scout type helicopters. The approach is to consider the several factors that make first round hits difficult, i.e., increased performance, a wide variety of weapons with their corresponding variations in ballistics, operation at long range and low altitude, and adverse visibility environments such as night/bad weather/vegetation/background clutter. The components and system efforts of this project consider operations under these conditions. The types of fire control hardware being developed will include, but not be limited to: computers; passive automatic trackers; mast mounted sight systems; night all weather acquisition and targeting systems; radar, infrared and stabilization systems. Foreign state-of-the-art trends and potential threats to present and future materiel or systems are being considered.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Design and fabrication of an advanced development model all-weather fire control system utilizing millimeter wave radar technology will be continued. Development, fabrication, and demonstration of a fully operable automatic target cueing system will be initiated. Initiation of a second-generation day/night mast-mounted sight will begin. This project will take the previously developed day television and laser rangefinder/designator technology and add forward looking infrared (FLIR) components to provide a night target acquisition capability above the helicopter rotor environment.

Program Element: # 6.32.06.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Aircraft Weapons
Budget Activity: #2 - Advanced Technology Development

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirement)	0	470	6466	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	0	470	2149	Continuing	Not Applicable

FY 1981 increases reflect added emphasis on the development of a millimeter wave radar for all-weather target acquisition. The mast-mounted signt/technology project is an effort aimed at expanding the technology base of mast-mounted sensors for aircraft, by exploring advanced sensors including radar and forward looking infrared (FLIR).

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 6.32.06.A Title: Aircraft Weapons
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to continue advanced development of airborne weapon subsystems for future use in helicopters. Proven concepts from exploratory development of new or improved aircraft weapon subsystems are evaluated and directed towards general aircraft use and 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.

G. (U) RELATED ACTIVITIES: Project personnel maintain close liaison 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 (AMARD), 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.

H. (U) WORK PERFORMED BY: Contractors are General Electric Company, Binghamton, NY: Electronic Communication Industries, St. Petersburg, FL; Bell Helicopter Company, Fort Worth, TX; Rockwell Interntional, Columbus, OH; Honeywell Inc., Minneapolis, MN. In-house: US Army Aviation Research and Development Command, St. Louis, MO; US Army Armament Research and Development Command, Dover, NJ; US Army Missile Command, Huntsville, AL; US Army Test and Evaluation Command, Aberdeen Proving Ground, MD; US Army Electronics Research and Development Command, Fort Monmouth, NJ.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Work performed with the goal of improved target acquisition has covered technology areas including electro-optics, infrared, millimeter wave radar, and improved stabilization. Specific efforts include the development and flight testing of airborne laser rangefinders (both galium arsenide and neogynium yag) as well as moving target indicator radars. A low-light-level television was evaluated on the AH-1G in conjunction with the night fire control system. Results indicated that this was not a sound technical approach. Infrared technology has been evaluated for weapon sighting systems at low-light levels and under adverse weather conditions. Automatic target tracking from an airborne platform was demonstrated using of a special purpose electronic processing unit operating from television and Forward Looking Infrared (FLIR) type video formats obtained from remote sighting systems. In the area of improved weapon subsystem effectiveness, the feasibility of 30mm and 40mm airburst fuzes and 30mm aluminum-cased ammunition was established. The feasibility of heliborne

Program Element: # 6.32.06.A Title: Aircraft Weapons
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

antiradiation missiles and use of semiactive lasers for guidance of point target weapons was demonstrated. Current programs are underway to further develop and field this technology. Shallow Cone Shaped Charge (SCSC) technology for High Energy Dual Purpose rounds was developed and is being incorporated into ammunition development programs. The REDEYE missile was tested and evaluated for air-launched use against ground targets. With respect to weapon system integration problems, specifications for external stores suspension equipment for Army aircraft were evaluated and are currently being used for the AH-1S and Advanced Attack Helicopter (AAH) systems. Airborne computers were evaluated on the Multiweapon Fire Control Testbed and specification input prepared for the AH-1S and the AAH fire control systems. To assist the AH-1S program, the feasibility of an integrated laser rangefinder with input to the rocket fire control subsystem was demonstrated on the XM-65 sight, and this hardware is now being incorporated into the AH-1S. In the area of recoil attenuation, a modified 20mm turret with a flight qualified hydraulic constant recoil mechanism was integrated and flight tested. A breadboard model of a mount for the development of a high impulse recoil attenuation device was completed. Based on the data obtained from medium impulse recoil tests, a detailed mathematical model of the recoil mechanism was programed into a computer to simulate burst firings. Data from this computer was used to further design a recoil mechanism that will be applicable to current attack helicopters. Data from the computer was also used to compare present recoil mechanism forces with mechanism forces for a new hydraulic constant recoil concept. Hardware has been developed and flight tested to evaluate Closed Loop Fire Control Systems concepts. Results have indicated that refinements are required to make significant improvements in system performance. To assist in the area of reducing detectability of a helicopter, and hence increasing survivability, fabrication and flight testing of a mast-mounted sight feasibility demonstrator was initiated. A contract has been awarded to Bell Helicopter for the design and fabrication of a nonrotating platform for a feasibility demonstration of the Mast-Mounted Sight on the OH-58C helicopter.

2. (U) FY 1980 Program: Flight testing of the Rockwell International Mast-Mounted Sight on the Bell Helicopter OH-58C will be completed. Development of an airborne all-weather target acquisition system utilizing millimeter wave radar technology will be initiated.

3. (U) FY 1981 Planned Program: Continued development of an airborne advance target acquisition system and planning for flight tests will be accomplished. Initiation of an automatic target acquisition system development program will take place. This effort will involve the further advancement of the automatic target cueing technology developed under Program Element 6.22.01.A, Aircraft Weapons Technology. The automatic target cueing technique was investigated under this exploratory development effort and it was determined that the technique can be applied to systems utilizing infrared and television acquisition principles. The ability to track and identify up to thirty targets will be investigated. Intelligent tracking automatic on-board target handoff, and passive ranging functions will be investigated. The airborne application of acoustics technology will be studied. Initiation of a second-generation day/night mast-mounted sight will begin. This Project will take the previously developed day television and laser rangefinder/designator technology and add forward looking infrared (FLIR) components to provide a night target acquisition capability above the rotor environment.

Program Element: # 6.32.06.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Aircraft Weapons
Budget Activity: #2 - Advanced Technology Development

4. (U) FY 1982 Planned Program: Fabrication of the airborne all-weather target acquisition system utilizing millimeter wave technology will continue. Installation of the system on an aircraft for test will be initiated. Development of the automatic target acquisition system built around automatic target cueing technology will be continued. Continue the development of a second-generation day/night mast-mounted sight. Development of improved 30mm medium impulse ammunition will be initiated. The effort is to develop 30mm ammunition with improved target penetration, post penetration effects, and spin sensitivity to defeat lightly armored vehicles. The approach is to incorporate shallow cone shape charged technology and the thinwall steel cartridge case technology into the family of 30mm ammunition. An air self-defense effort will be initiated. Efforts will focus on lessons learned from previous experimentation, hardware development, and system analysis efforts. Request for Proposals will be prepared for a hardware development program addressing issues such as location and type of acquisition devices, weapon system type (guns, rockets, missiles), and ammunition concepts. Two contracts will be awarded covering fabrication of hardware suits for integration into scout and attack helicopters. Follow-on efforts include flight testing to quantify benefits of these systems for air self-defense capability.

5. (U) Program to Completion This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.07.A Title: Aircraft Avionics Equipment
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	804	1930	4198	13352	Continuing	Not Applicable
	QUANTITIES						Not Applicable
D896	Aircraft Navigation & Control Equipment	0	300	150	2612		
D897	Avionics Equipment	804	745	2471	4731	Continuing	Not Applicable
D312	Nap-of-the-Earth Essential Equipment Development	0	885	1577	6009	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Army aircraft must have the improved capability to operate at low-level, nap-of-the-earth (NOE) altitudes while supporting ground combat forces at night and during adverse weather. This program element supports this requirement by providing technology demonstration and advanced development leading to engineering development of avionics and related ground equipment. Emphasis is on the hardware which will provide this capability through improved navigation and control systems, improved avionics packages, and nap-of-the-earth equipment such as target handoff and sensing systems.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Testbed research aircraft will be used to test advanced development hardware such as electronic map, digital communications package, and displays. Previous effort on a target handoff system will continue. The FY 1981 request supports continuation for managing the Joint Tactical Microwave Landing System (JTMLS) Development Contractual effort by the JTMLS lead service program office. A contract is planned for award in FY 1980 for the design and fabrication of Advanced Development models. Funds ($6.5M) for this effort were transferred from the FAA to DOD.

Program Element: #6.32.07.A
DOD Mission Area: #551 - Electronic & Physical Science (ATD)
Title: Aircraft Avionics Equipment
Budget Activity: #2 - Advanced Technology Development

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	804	1930	4198	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	804	1945	6374	Continuing	Not Applicable

FY80 decrease is the result of a general Congressional reduction. FY81 funds for JTMLS and a wire and wire-like object detection system were decremented to finance higher priority programs.

E. (U) OTHER APPROPRIATION FUNDS: ($ in thousands): Not Applicable.

Program Element: #6.32.07.A Title: Aircraft Avionics Equipment
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION:

The Federal Aviation Administration (FAA) manages and funds the National Microwave Landing System (NMLS) development. However, in accordance with mutual agreements between the FAA and Department of Defense (DOD), funds ($6.5M) and management responsibilities were transferred to DOD for the development of the first military system, the Joint Tactical Microwave Landing System (JTMLS). The House Appropriations Committe (HAC) supported the DOD/FAA agreement to transfer the funds for the JTMLS development from the FAA to DOD. Program management responsibilities for the military systems are now assigned to DOD. Office of the Under Secretary of Defense for Research and Engineering (OUSDRE) designated the Army as lead service for the JTMLS development. Although civil MLS equipment has been developed for test and evaluation, equipment to satisfy military requirements has not been developed. For the military, there are several key technical issues affecting the acceptance and ultimate design which have not been totally resolved. They are: adequacy of the proposed precision L-Band Distance Measuring Equipment (DME), feasibility of operation in a tactical environment, performance of reduced-size ground antennas, and adequacy of collocated azimuth/elevation ground unit operation. DOD's concentration during the Advanced Development phase will be on addressing these critical issues rather than on preparing for production or fully militarizing the equipment. Satisfactory resolution of these issues could permit DOD to enter Engineering Development and preparation for production. 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 system, 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. Work includes development of cockpit instrumentation tailored to flight characteristics and mission profiles of Army helicopters, improvement of the man-machine interface, and provision of new sensors for detection and avoidance of obstacles ranging from wires to terrain masses. In the advanced development of subsystems to enhance helicopter nap-of-the-earth (NOE) operations, the initial emphasis is on improved target handoff capability. Subsystems developed under this project are expected to have a direct positive impact on combat helicopter mission efficiency.

G. (U) RELATED ACTIVITIES: Related programs of the Air Force (Program Elements 6.32.03.F, Project 666A, Advanced Aircraft Navigation; and 6.32.30.F, Project 2472, Synergistic Strike System), Federal Aviation Agency (Helicopter Instrument Flight Rules Research program), and other organizations are monitored by the Army through committees and working groups. The Joint Tactical Microwave Landing System (JTMLS) program will capitalize upon the collective background and technology base already established through ongoing development of the Federal Aviation Administration's (FAA) civil Microwave Landing System. The FAA program has proceeded through the technique analysis/contract definition and feasibility demonstration phases and prototype development and evaluation phase. Cost reduction is pursued through joint developments and hardware standardization. This program element is related to Army Program Elements 6.22.02.A, Aircraft Avionics Technology, and 6.42.01.A, Aircraft Avionics.

Program Element: #6.32.07.A Title: Aircraft Avionics Equipment
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

H. (U) WORK PERFORMED BY: Avionics Research and Development Activity and Project Manager, Navigation and Control, American Electronic Laboratory, Colmar, PA; Bell Northern Research Corp., Ottawa, IA; E. Systems, Greenville, TX; Sikorsky, Stratford, CT; Raycomm, Freehold, NJ; United Technologies Research Center, E. Hartford, CT; Analytical Science Corp., Reading, PA; ANACAPA Sciences, Santa Barbara, CA; Bendix, Towson, MD; and Texas Instruments, Dallas, Texas.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Flight tested a system for tactical hover, using 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. Successfully conducted nap-of-the-earth (NOE) communication 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 determined noise reduction was necessary. Developed specifications for audio applique unit (utilizing auto correlation noise cancelling techniques) to reduce headset noise. Developed improved microphone/headset. Developed device to filter out helicopter transmission noise. Evaluated commercial model of broadband automatic direction-finding device and found it acceptable for military application. Accomplished computer modeling of aircraft vulnerability, survivability, performance, and avionics reliability. Completed development of voice gating circuitry. Awarded a contract for a design approach for a Laser Wire Detection System for a candidate Wire and Wire-Like Object Detection System. Evaluated cockpit lighting techniques and determined new techniques better meet the current requirements. Completed investigation of state-of-the-art low-airspeed sensing system and achieved very acceptable results. 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. Successfully conducted steady state hover tests of night navigation and pilotage system and gained valuable results to be used in further development. Awarded contract for feasibility models of airborne data transfer system. Completed program in the areas of program planning, preparation for the International Civil Aviation Organization (ICAO) Divisional meeting in April 1978, proposal evaluations, tri-Service testing of civil avionics, and preparing specifications for military equipment. Established Lead Service Program Office (LSPO) with supporting rationale and documentation. Conducted a cost/performance trade-off study, for tactical and military landing systems which will be used as a basis for future developments. Procurement data package for the Joint Tactical Microwave Landing System (JTMLS) Advanced Development Program was completed, which resulted in a request for proposals (RFP). A tri-Service team was established to evaluate bidders proposal. Evaluation of bidders proposal began 4th Quarter FY79.

2. (U) FY 1980 Program: The terrain correlation navigation system flight test program initiated in FY79 will be completed. Computer-generated landing symbology will be flight tested and expanded to include integration with the terrain

Program Element: #6.32.07.A Title: Aircraft Avionics Equipment
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

correlation navigation system. This mode using computer-generated symbology and a laser obstacle terrain avoidance warning system will be flight tested in a research aircraft. Contracted for the design, fabrication, and testing of a target handoff system for the Advanced Attack Helicopter. Results of the design approach for a Laser Wire Detection System will be used in conjunction with Wire Obstacle Warning System (WOWS) and Laser Obstacle Terrain Avoidance Warning System (LOTAWS) test data to determine specifications for a Wire and Wire-Like Object Detection System for which a Letter of Agreement (LOA) is anticipated in FY80. A contract is planned for award for the design and fabrication of Advanced Development models of the Joint Tactical Microwave Landing System (JTMLS). This contractual effort will be managed by the JTMLS Lead Service Program Office (PM NAVCON). The JTMLS Lead Service Program Office will also continue to coordinate with the Federal Aviation Administration (FAA) and other Department of Defense (DOD) elements on specifications and standards relative to the JMTLS and National Microwave Landing System (NMLS) Program.

3. (U) FY 1981 Planned Program: A digitally generated electronic map will be flight tested. Initiate a program to develop Electronic Master Monitor Display System (EMMADS) for attack, scout, and utility helicopters. Initiate engineering effort to formulate an advanced state-of-the-art aircraft communications package featuring digital communication techniques for both voice and data transfer and data bus compatibility. Continue developing improvements in aircraft speech communications in the nap-of-the-earth (NOE)/Electronic Warfare environment. Transition electronic master monitor advisory display system from exploratory development. Complete a Letter of Agreement (LOA) for a solid state programmable multiformat display aimed at simplified cockpit layout and reduced aircrew workload. Continue contractual effort on a target handoff system. The JTMLS Lead Service Program Office will continue to manage the JTMLS Advanced Development contractual effort and will continue to coordinate with the FAA, North Atlantic Treaty Organization (NATO), and other DOD elements on specifications and standards relative to the Joint Tactical Microwave Landing System (JTMLS) and National Microwave Landing System (NMLS) Programs. Prepare and coordinate test plans and initiate plans for tri-service testing of JTMLS equipment.

4. (U) FY 1982 Planned Program: The goal is to develop an avionics system with integrated sensors, processors, controls and displays, and target handoff capability. Toward this goal, existing avionics systems will be installed in a research aircraft via a 1553 B digital data bus and bus controller. Continue EMMADS effort toward flight test of the system. Effort will continue on the communications package which will utilize the same bus. Programs to improve speech intelligibility and aircraft communication will continue. Incrementally funded programs to develop an electronic master monitor advisory display system will continue. Effort will continue on a programmable solid state multiformat display. Perform development and operational testing on the target handoff system. Initiate a new start for the design and fabrication of the Airborne Night Navigation/Pilotage Equipment and ground-based mission planning stations. The equipment will provide a basic capability required for all day/night missions in a nap-of-the-earth environment. Contract for a new start wire and wire-like object sensor capability to allow aircraft to fly nap-of-the-earth by avoiding wire-like objects. Conduct tri-Service testing of JTMLS equipment. Initiate plans for follow-on Engineering Development program.

Program Element: #6.32.07.A
DOD Mission Area: #551 - Electronic & Physical Science (ATD)
Title: Aircraft Avionics Equipment
Budget Activity: #2 - Advanced Technology Development

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.09.A
Title: Air Mobility Support
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	300	650	1969	2382	Continuing	Not Applicable
DB31	Manufacturing Technology	0	0	401	898	Continuing	Not Applicable
DB33	Cargo Handling Equipment	0	0	349	517	Continuing	Not Applicable
DB45	Aviation Life Support	0	150	415	967	Continuing	Not Applicable
D103	HelicopterAnti-/De-icing	300	500	804	0	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports the advanced development and testing of air-mobility prototype support equipment and concepts through the use of advanced systems hardware demonstrations. The concepts being developed are designed to enhance the efficiency, safety, and survivability of air crewmembers operating in a hostile tactical environment.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Manufacturing Technology: Develops a technique for producing spiral bevel gears which have increased life and load-carrying capabilities. Cargo handling equipment: Initiates the evaluation of hardware design for the helicopter external Gondola system and begins development test/operational test (DT/OT). Completes prototype design and initiates DT/OT of the Military Container Lift Adapter. Aviation Life Support: Develops individual items of equipment to enhance the overall crew safety and survivability both while in the aircraft and in a hostile environment if forced to leave the aircraft. The FY 1981 effort will concentrate on the design and fabrication of an advanced development of prototype hardware for aircrew inflatable body and head restraint system and Integrated Aircrew Helmet System. Helicopter Anti-/de-icing: Completes flight evaluation of ice-protected critical components including an evaluation of advanced development on ice phobic coatings for main rotor helicopter blades.

Program Element: #6.32.09.A Title: Air Mobility Support
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirement)	300	650	1969	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	286	650	1990	Continuing	Not Applicable

Differences from the FY 1980 Congressional Descriptive Summary reflect realignment of priorities within the Service and an increased emphasis on Manufacturing Technology and development of Cargo Handling Equipment.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.32.09.A Title: Air Mobility Support
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to continue advanced development of conceptual prototypes that allow new items of mission support equipment to enter engineering development. Efforts underway in this program will lead to development of hardware needed to support current and future aircraft systems and to enhance the safety and survivability to the aircrew/aircraft. The projects under this program have transitioned from exploratory developments. The following projects comprise the program element. Manufacturing Technology: Planning initiated in FY 1978-1979 for a FY 1981 start. Ground Support Equipment (GSE): Evaluates off-the-shelf equipment on conceptual prototype and concepts to improve and enhance ground support to current and future aircraft systems. Cargo Handling Equipment: Development of new concepts and techniques critically needed for movement of cargo by helicopter. Equipment developed will enhance the mobility of Army and Marine field units and will enhance the tactical deployment of priority equipment, supplies, and munitions. These projects are unfunded in FY 1980 & FY 1981. Aviation Life Support Equipment (ALSE): Equipment will be developed to provide safety to the aviator and increase his survivability in the aircraft and on the ground and to minimize crew injuries by reducing the safety hazards associated in current and future aircraft systems. Helicopter Anti-/De-icing: Analysis of helicopter adverse weather capability has led to advanced development of electrothermal anti-/de-icing systems for rotor blades and other critical components. Applications of ice phobic coatings techniques offers a means of providing a simple, cheap, easy-to-apply ice protection to Army helicopters. This work is being jointly funded with the Federal Aviation Administration.

G. (U) RELATED ACTIVITIES: Aeronautical Technology Program Element 6.22.09.A: Air Mobility Support Equipment; Helicopter Anti-/De-icing efforts are coordinated with NASA, FAA, USAF, and USN. Project personnel maintain coordination with NATO activities in helicopter icing by participation in a subgroup on Helicopter Icing. Related Cargo handling equipment engineering development is conducted under PE 6.42.04.A (Air Mobility Equipment). Cargo handling equipment developments are closely coordinated with airdrop developments through the Joint Technical Coordinating Group for Airdrops. Project personnel maintain close liaison with other military services and industry as well as participate in Joint Working Groups.

H. (U) WORK PERFORMED BY: Contractors: Naval Air Development Center; Boeing-Vertol, Ridley Park, PA; Sikorsky Aircraft Co, Stratford, CT; Kaman Aviation, Windowlock, CT; Bell Helicopter, Dallas, TX; Brooks and Perkins, Cadillac, MI; Martin-Marietta Science, Salt Lake City, UT; Air Research, Phoenix, AZ; Western Gear, Jamestown, ND. In-house: US Army Aviation Research and Development Command, St. Louis, MO; US Army Test and Evaluation Command, Aberdeen Proving Ground, MD; US Army Training and Doctrine Command (TRADOC), Ft. Monroe, VA; US Army Troop Support & Aviation Material Readiness Command, St. Louis, MO.

Program Element: #6.32.09.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Air Mobility Support
Budget Activity: #2 - Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Cargo Handling: The design, fabrication, and flight test of a closed-loop, active arm stabilization system was sucessfully completed and demonstrated. The design of a militarized container lift adapter for development test/operational test (DT/OT) and fabrication of test hardware was completed. Aviation Life Support Equipment (formerly Subsystems and Components): Requirements for the Aircrew Integrated Helmet have been completed. Helicopter Anti-/De-icing: Project started in 1977 with analysis of ice protection requirements for Army helicopters. Design, fabrication, and installation of ice-protected components for UH-1H test demonstration helicopter were initiated. Initial flight tests in both natural and simulated icing conditions have been comp'eted. The objective of these tests were to expand the icing test envelope and to gather additional data on ice protection system design and performance characteristics.

2. (U) FY 1980 Program: Aviation Life Support Equipment: Initiate advanced development of the Inflatable Body and Head Restraint System which successfully completed exploratory development under US Navy lead. Award of incrementally funded contract for the design and fabrication of advanced development prototype. Initiate advanced development of the Aircrew Integrated Helmet System by award of a competitive contract to be incrementally funded for design and fabrication of advanced development prototypes. Helicopter Anti-/De-icing: Continue the verification of established design criteria for de-icing equipment and correlation of natural icing tests. Suitability of ice phobics protection initiated as a joint Army/Federal Aviation Administration (FAA) program.

3. (U) FY 1981 Planned Program: Aviation Life Support Equipment: Continuation of development of the Inflatable Body and Head Restraint system initiated in FY 1980. Completion of in-house laboratory tests. Initiation of developmental and operational tests (DT/OT). Continue development of Aircrew Integrated Helmet System initiated in FY 1980. Manufacturing Technology: Initiate development of new techniques for producing spiral bevel gears to increase item life expectancy and reduce costs. Cargo Handling Equipment: Container Lift Adaptor to interface with the Gondola system will progress through the fabrication and contractor tests of prototype hardware and will undergo developmental/operational testing. Helicopter Anti-/De-icing: Advanced development testing of ice phobics ice protection concepts will continue with new ice phobic rotor blade coating materials. Ice phobic coatings offer the potential to permit operations in icing conditions with minimum aircraft weight and complexity penalties.

4. (U) FY 1982 Planned Program: Aviation Life Support Equipment: Initate development of the Improved Lighting System (ILSAA-II) to identify candidate systems for current aircraft fleet. Complete engineering and operational tests of Inflatable

Program Element: #6.32.09.A Title: Air Mobility Support
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

Body and Head Restraint System. Continue development of the Integrated Aircrew Helmet System. Enter item for development test/operational test (DT/OT I) late in fiscal year. Manufacturing Technology: Development of advanced spiral bevel gears will continue. Development of a composite rotor hub and wet filament winding of contour tubular elements will be initiated. Cargo Handling Equipment: Container Lift Adapter advanced development will continue with completion of joint user/developer developmental/operational testing followed by validation IPR and transition to engineering development. Fabrication of full-scale prototype Gondola hardware will continue and test planning will be completed. Helicopter Anti-/De-icing: Advanced development of rotor-blade ice protection concepts will be continued predicated on successful FY81 test results.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.11.A
Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3352	5890	13779	31553	Continuing	Not Applicable
D841	Advanced Structures	700	2500	7050	15053		
D157	Advanced Rotors/Flt Ctls	2652	0	0	0	0	Not Applicable
D313	Research Aircraft Systems	0	350	502	504	Continuing	Not Applicable
D314	Advanced Rotor Systems	0	926	931	6853	Continuing	Not Applicable
D315	Advanced Flight Controls	0	2114	5296	9143	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army's advanced development programs for rotary wing structures, research aircraft systems, rotors, and flight controls provides for the development and demonstration of full-scale aircraft components and subsystems for advanced concept demonstration of improvements for advancing the US Army rotary wing technology. An advanced aircraft structures technology base will be developed as a major thrust to evaluate potential for increased combat survivability, improved reliability and maintainability, lower weight, and longer life with substantial life cycle cost saving over conventional metal structures. Likewise, advance rotors and flight controls permit validation of state-of-the-art technology through a systems approach for future aircraft including product improvements to existing aircrafts.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: D841: Continues the Army's advanced composite airframe program (ACAP) to demonstrate that composite materials can be utilized as primary structural component consistent with the environment expected for Army aircraft. D313: Continues support requirements to maintain research aircraft used in exploratory and advanced development necessary to permit flight demonstrations of emerging new concepts. Research aircraft include the Rotor Systems Research Aircraft (RSRA), the UH-1H in-flight simulator, XV-15 Tilt Rotor, and other aircraft participating in joint Army/NASA projects. D314: Continuation of the Army's advanced rotor system demonstration program. D315: Continuation of the Army advanced digital-optical flight control demonstration program for rotary wing applications.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

Program Element: #6.32.11.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Rotary Wing Controls, Rotors, and Structures
Budget Activity: #2 - Advanced Technology Development

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	3352	5890	13779	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	3352	5900	14060	Continuing	Not Applicable

The FY80 decrease is the result of general Congressional reduction. The FY 1981 request reflects a minor program restructuring and descoping of research objectives.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.32.11.A
DOD Mission Area: #551 - Engineering Technology (ATD)

Title: Rotary Wing Controls, Rotors, and Structures
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This advanced development program provides for the development, verification, and demonstration of technology in areas currently restricting Army airmobile systems. This continuing program is formulated on the basis that advances in state-of-the-art technology will be made only if technology is validated and technical confidence is gained through component or system demonstration in actual or simulated flight conditions. The program includes efforts in advanced rotors and flight control systems, and in the application of advanced structures. Foreign state-of-the-art trends and potential threats to the present and future materiel systems have been considered.

G. (U) RELATED ACTIVITIES: The technology being developed and demonstrated in this program is closely coordinated and related to Navy, Air Force, and National Aeronautics and Space Administration (NASA). Duplication of effort is avoided through coordination with these agencies and on a continuing basis through joint program reviews, exchange of information and reports, the Technical Cooperation Program, NASA Research and Technology Committees, North Atlantic Treaty Organization (NATO) Standardization Agreements (STANAG's), and the NATO 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 under development. The Tilt Rotor Research Aircraft program is jointly funded by the Army, Navy, and NASA. The rotor research programs 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. Numerous tasks in this program had their origin within efforts performed in Program Element 6.22.09.A, Aeronautical Technology.

H. (U) WORK PERFORMED BY: This work is performed by the Research and Technolgy 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 Vertol Company, Philadelphia, PA; Kaman Aerospace Corporation, Bloomfield, CT; and Bell Helicopter Textron, Fort Worth, TX. Much of the contract work is competitive, and the contractors are to be determined. The total anticipated contract dollar value for FY 1981 is approximately $11,000,000.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Maturity of a Bearingless Main Rotor (BMR) flight evaluation program progressed through the design and analysis phases, completion of wind tunnel tests of the BMR/BO-105 helicopter, and completion of ground testing of components and rotor. A High Energy Rotor (HER) was flight tested to demonstrate the potential to eliminate

Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

the pilot's concerns related to the ability of the aircraft to execute a safe autorotation. A fan-in-fin antitorque 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 demonstrating alternatives to future stability systems. 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 Aircraft. Preliminary program planning for incorporation of an advanced fly-by-wire control system was initiated. The composite airframe demonstration program was initiated. The Composite Multi-Tubular Spar main rotor blade for the AH-1G has been successfully flight demonstrated. From this program the Improved Main Rotor Blade for the AH-1S evolved. A composite tail section has been designed for the OH-58 and will be flight tested and put into limited service soon in order to accumulate flight service experience with a composite structure. A Structural Integrity Recording System (SIRS) for monitoring fatigue damage accumulation on dynamic components has been flight demonstrated. Several major items for nondestructive tests have been acquired. Innovative composite ballistic tolerant structural concepts have been successfully demonstrated in multiple explosive projectile impact tests. High energy absorption landing gear have been designed and tested.

2. (U) FY 1980 Program: A 25-hour flight test program on the Bearingless Main Rotor (BMR) on the BO-105 helicopter continues to determine loads, rotor stability, and handling qualities. Flight test data analysis will confirm the capability to predict structural and aeroelastic response, loads, rotor stability, handling qualities and performance characteristics of the BMR to first order values. Funding was also 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 have been developed. Baseline noise data on the RSRA S-61 rotor was initiated using the In-Flight Far-Field Impulsive Noise Measurement concept. A set of helicopter configurations to systematically investigate individual basic handling qualities characteristics such as speed stability or cross-coupling limits using the UH-1H helicopter in-flight simulator were undertaken.

3. (U) FY 1981 Planned Program: DB41: Phase II of the advanced composite airframe program (ACAP) will be initiated using the two most promising composite airframe concepts. Detailed design will be completed and testing will be conducted on the necessary design support elements representing critical airframe sections and subassemblies to substantiate the design selection and verify critical design concepts. A separate effort will be initiated to develop a composite main rotor hub with two contractors. The composite main rotor hub will be designed to improve reliability and maintainability by 50%, reduce radar cross section by 70%, reduce cost and weight by 30%, and reduce parts count by 60% compared with conventional rotor hubs. A composite tailboom on the OH-58C will be placed into limited service to accumulate flight experience and environmental durability data. D313: Contributes the Army's share of supporting flight operations of research aircraft--Rotor Systems Research Aircraft (RSRA) XV-15 Tilt Rotor Aircraft, and the UH-1H in-flight simulator. D314: Additional testing to expand the

Program Element: #6.32.11.A
DOD Mission Area: #553 - Engineering Technology (ATD)
Title: Rotary Wing Controls, Rotors, and Structures
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demonstration envelope of advance rotors program will be initiated. Rotor technology programs will make use the RSRA's unique capabilities to accurately measure/record rotor loads, vibration, and performance. Evaluation of handling qualities configurations on advance flight control concepts using the UH-1H helicopter in-flight simulator for daylight tasks will also be explored. Incorporation of visual aids in the simulation for extending the evaluation to simulated night and poor visibility conditions will continue. D315: A program to design, fabricate, bench test, and flight test a helicopter digital Fly-By-Optics (FBO) control system will be continued. In support of this effort, development of reliability concepts will be evaluated. In support of digital FBO systems, test of digital mechanizations for fiber optical systems will be evaluated, designed, and fabricated.

4. (U) FY 1982 Planned Program: D841: Phase II of the advanced composite airframe program (ACAP) will be completed and phase III will be initiated. These airframes will be fabricated by each contractor for use in structural tests, ground test and an engineering flight test evaluation. In FY 1982, a major ACAP program review will be conducted to review these test results prior to ACAP airframe fabrication. Fabrication will also begin on the composite main rotor hub. Costs of composite main rotor blades can be significantly reduced with new manufacturing processes and design concepts. A program to provide the basis for this low-cost, second-generation composite main rotor blade will be initiated. D314: An integrated advanced technology rotor program using the desirable characteristics of Bearingless Main Rotor (BMR) envelope expansion will be initiated. As a follow-on to the High Energy Rotor program, a program to design, fabricate, and test an advanced combat rotor will be initiated taking advantage of new composite materials. Rotor designs will be optimized to provide improved safety, controllability, and improved helicopter stability, especially for nap-of-the-earth conditions. Design and fabrication of an advanced technology rotor and other rotors using the RSRA will continue. D315: Hardware fabrication for the Fly-By-Optics (FBO) system will continue leading to a competition for development of an all-digital system. A program to integrate the digital-optical flight system into a selected aircraft will be initiated.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #DB41 Title: Advanced Structures
Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this project is to promote and demonstrate advanced structures technology for helicopters. This program is designed to reduce the technical risk and demonstrate that composite materials technology can be successfully applied to primary rotorcraft aircraft structures to gain significant system improvements including: reduced weight, cost, ballistic damage tolerance, reduced radar cross section, enhanced crashworthiness, reduced maintenance and benefits related to operating in a hostile technical environment which are not possible by using conventional metal structure. The technology resulting from this program will be applicable to current aircraft and future Army aircraft systems and ultimately benefit other DOD services and the US helicopter industry.

B. (U) RELATED ACTIVITIES: The technology being developed and demonstrated in this program is related to Navy (62241N - Aircraft Technology) and the National Aeronautics and Space Administration (NASA) Research and Technology Objectives Plan (505-42-13). Duplication of effort is avoided by coordination with these agencies on a continuing basis through: joint program reviews, exchange of technical data and reports, The Technical Cooperation Program (TTCP), NASA research and technology committees, North Atlantic Treaty Organization (NATO) Standardization Agreements (STANAGS), and the NATO Advisory Group on Aerospace Research and Development. Specifically, this program is included in the tri-Service Aeronautical Vehicle and Structures Technology Coordinating Papers (TCP). Efforts under this program are related to work being accomplished under Program Element 6.22.09.A, Aeronautical Technology (Tech Area - AH76B). In 1979, as part of the joint Army-NASA agreement, the NASA Langley Research Center and the collocated Army Structures Laboratory (Army Aviation Research and Development Command) have recently structured a comprehensive Advanced Rotorcraft Technology Program to follow and compliment the Army's Advanced Composite Airframe Program (ACAP) to investigate second-generation concepts for civil applications. These two programs are being closely coordinated to avoid duplication and derive maximum advancements in composite technology.

C. (U) WORK PERFORMED BY: This work is performed by the Applied Technology Laboratory at Fort Eustis, Virginia, a part of the US Army Aviation Research and Development Command. For FY 1981 two contractors will be competitively selected from Phase I concepts being developed by five prime helicopter companies including Hughes Helicopters, Sikorsky Aircraft, Boeing Vertol Company, Bell Helicopter Textron, and Kaman Aerospace Corporation. The total anticipated contract dollar value for FY 1981 is $8,000,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Phase I of the Army's Advance Composite Airframe Program (ACAP) was initiated

Project: #DB41 Title: Advanced Structures
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in FY 1979 as the principal effort for project number DB41. The first phase was preliminary concept design solicitations from all of the prime helicopter companies. This phase included trade-off investigations and concept selections with emphasis on choosing the best concepts for composite structural joining, fabrication, assembly, and tooling. All primary and secondary airframe structures designs considered maximum benefits from weight, cost, producibility, maintainability, vulnerability, and survivability.

2. (U) FY 1980 Program: Phase I completed. Two technical approaches selected for detailed design of the most promising composite airframe concepts. Phase II (Detail Design of Testing) planning initiated. Technical personnel were drawn from the Army Research community including the Ballistics Research Laboratory (BRL) and the Army Materiel and Mechanics Research Center (AMMRC), and additional personnel from NASA, the Navy, and the Air Force provided expertise for the Phase II selection. Phase II contract awarded. Input considered from related exploratory/advanced development technology program includes: aeronautical, structures, propulsion, avionics, reliability and maintainability, and safety and survivability. The FY 1980 program collectively includes the completion of Phase I and initiation of Phase II.

3. (U) FY 1981 Planned Program: Phase II continuation with contractors' effort being devoted to development of detail design and structural design criteria. Validation of design concepts through design support testing of critical sections such as the airframe/transmission and airframe/landing gear interfaces will be conducted to verify specific design integrity. The manufacturing and test plans for the full-scale airframe (Phase III) will be developed. Continued in-house management is derived from Army, Navy, Air Force, and NASA expertise. Program coordination with NASA's Advanced Rotorcraft Technology Program will provide basis of addressing second-generation advanced composites program.

4. (U) FY 1982 Planned Program: Phase II completion. In-house government review/approval is conducted for preparation of Phase III. Design update and fabrication refinement will be reviewed and considered prior to initiation of full-scale airframe fabrication and flight demonstration. Influences and recommendations from peripheral program will be considered and provided to both contractors for updating final designs for Phase III flight evaluation.

5. (U) Program to Completion: Following the fabrication of the full-scale airframe, specific laboratory structural test and ground/flight test will be supported. As part of a continuation of advancing the technology, supporting peripheral programs will be concurrently conducted to provide baselines for evaluating final composite airframe designs. Expected completion of the Advanced Composite Airframe Program (ACAP) is 3rd Qtr, FY 1984. Continuing refinements are planned based on the successful outcome of the Army's advanced composite airframe program and the related advanced composite rotorcraft technology program of NASA.

Project: #DB41 Title: Advanced Structures
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6. (U) Major Milestones:

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1980 Submission
Phase I Completion	3Q FY 1980	Not Shown
Phase II Award	4Q FY 1980	Not Shown
Phase II Completion	3Q FY 1982	Not Shown
Phase III Award	3Q FY 1982	Not Shown
Phase III Completion/ ACAP Program Completion	3Q FY 1984	Not Shown

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	700	2500	7050	15053	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	700	2500	6760	N/A	Continuing	Not Applicable

The increase for the FY 1981 estimate from the FY 1980 submission reflects minor adjustments to refine the Army's Advanced Structures program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D315 Title: Advanced Flight Controls
Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to advance and demonstrate flight control technology for Army aircraft through development, verification, and validation of improved flight control concepts. This is necessary to provide improved mission capability, survivability, reliability, maintainability, crew-aircraft interface, and cost effectiveness of current and future rotorcraft weapons systems. The program includes the integration of flight control system logic, mechanization, displays, sensors, and control media into the aircraft system. The program is designed to function with digital avionics and fiber optics. The overall thrust of the program effort is to permit pilots to perform multifunctional missions without being saturated by excessive workloads. Critical missions include tactical flight profiles for nap-of-the-earth/low level terrain flying during adverse weather and hostile battlefield conditions for both day and night operations.

B. (U) RELATED ACTIVITIES: The technology being developed and demonstrated in this program closely follows related Navy (62241N, Aircraft Technology), Air Force (62201F Flight Dynamics), and National Aeronautics and Space Administration (NASA) programs (Research and Technology Operations Plan: 505-42-31). Coordination with these agencies and others is accomplished on a continuing basis: joint program reviews; exchange of technical information and reports; execution of joint programs; and program interfaces required as part of the Department of Defense Tri-Service Aeronautical Vehicle Technical Coordinating Paper (TCP). Program duplication of effort is also avoided through technical panel and action group coordination as a part of The Technical Cooperation Program (TTCP), NASA's Research and Technology Committees, North Atlantic Treaty Organization (NATO) Standarization Agreements (STANAG's) and the NATO Advisory Group on Aerospace Research and Development (AGARD). This program is related to the activities under Program Element 6.22.09.A, Aeronautical Technology, as well as major Army aircraft systems under development.

C. (U) WORK PERFORMED BY: This work is performed by the Research and Technology Laboratories, a part of the US Army Aviation Research and Development Command. Laboratories located at Moffett Field, CA, and Fort Eustis, VA, will execute the program. Work in related activities is also performed by the National Aeronautics and Space Administration (NASA) Ames located at Moffett Field, CA. The contracts for FY80 will be competitively determined. The total anticipated contract dollar value for FY81 is approximately $4,000,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Not Applicable

Project: #D315 Title: Advanced Flight Controls
Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1980 Program: This program was initiated in FY 1980 to provide the means of developing advanced flight control technology prior to incorporating into engineering development for new aircraft or product improvements to existing systems. The 1980 program initiates studies orientated to the development of digital optical concepts and component development. Included in the digital optical component developed is sensors/transducers, optically controlled actuators, study and testing of commercially available control media as applied to rotary-wing flight control applications and multiplexing requirements. Effort to establish the advanced flight control architecture will be initiated.

3. (U) FY 1981 Planned Program: Validation of work initiated in FY 1980 continues. In FY 1981 system alternatives using digital optical flight control systems will be selected from a competitive solicitation. This includes the design, fabrication, and verification of advanced digital flight control concepts and advanced cockpit controls for minimum pilot workload. A supporting technology program for man-machine implementation will be initiated for future integration into the overall aircraft system flight control architecture.

4. (U) FY 1982 Planned Program: Digital components development phase completed. Digital optical flight control system development continues. Interaction of advanced rotor control concept and advanced cockpit control continues. Man-machine integration continues. Second generation improvements are identified.

5. (U) Program to Completion: Application of selected flight control concepts into flight demonstration. The vehicle selected for flight demonstration will be of competitively selected during FY 1983. During FY 1984 a full-up flight demonstration and verification of the flight control system will be demonstrated.

6. (U) Major Milestones: Not Applicable

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	0	2114	5296	9143	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	0	2119	3700	Not Shown	Continuing	Not Applicable

Project: #D315 Title: Advanced Flight Controls
Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

The adjustment in FY 1981 ($1596) reflects the Army's decision to modify the schedule and completion date of the advanced flight control technology program. The FY80 decrease is the result of a general Congressional reduction.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.16.A Title: Synthetic Flight Simulators
DOD Mission Area: #552 - Environ & Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1500	1200	6883	11598	Continuing	Not Applicable
DB34	Rotorcraft Systems Integration Simulator (RSIS)	1500	1200	5772	4468	Continuing	Not Applicable
DB35	Aviator Training Research Simulator (ATRS)	0	0	0	3494	Continuing	Not Applicable
DB39	Flight Simulator Components	0	0	1111	3636	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for the development of a versatile, high-fidelity, ground-based, helicopter simulator to support Army aviation system and training developments. Simulation uses include support of conceptual design trade-offs, prototype development, flight tests, product improvement evaluations and analysis of aircraft accident investigations for accident prevention (DB34); examination of training techniques for initial entry training, transitional/refresher training and combat readiness flying (DB35); and development of advanced flight simulation components and systems for incorporation into future flight training systems (DB39).

C. (U) BASIS FOR FY 1981 RDTE REQUEST: To initiate advanced engineering development and demonstrate a dual cathode ray tube visual display system capable of high resolution simulation up to the maximum effective aerial weapon ranges. Complete advanced development engineering for the remaining three major components of the Rotorcraft System Integration Simulator (RSIS). This engineering effort includes the interchangeable rotorcraft simulator cab, an augmented station for the cab, and an advanced visual system. Continue incremented development for the ongoing motion generator development.

Program Element: #6.32.16.A Title: Synthetic Flight Simulators
DOD Mission Area: #552 - Environ & Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1500	1200	6883	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	400	1200	5550	Continuing	Not Applicable

The increase in FY 1979 and FY 1981 is a result of a decision to accelerate the Rotorcraft Systems Integration Simulator (RSIS) development in order to align research efforts with the National Space and Aeronautics Administration (NASA) program.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.32.16.A Title: Synthetic Flight Simulators
DOD Mission Area: #552 - Environ & Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Rotorcraft Systems Integration Simulator (RSIS): Numerous studies including the Army Scientific Advisory Panel (ASAP) Ad Hoc Working Group on Research Facility Requirements for Nap-of-the-Earch (NOE) Day/Night Visual Flight Studies recommended that the Army, who represents the lead Service for helicopter R&D, place increased emphasis on research and development in helicopter flying qualities using ground-based simulation. The Rotorcraft Systems Integration Simulator (RSIS) expands the capabilities of the National Aeronautics and Space Administration (NASA) Vertical Motion Simulator, exploiting the joint Army-NASA agreement to minimize costs and obtain technical expertise in the development of this aeronautical engineering research facility. The Army Scientific Advisory Panel (ASAP) also recommended a modest increase in flexibility of an existing training simulator for research on training. The Aviator Training Research Simulator (ATRS) Letter of Agreement (LOA) is being staffed between TRADOC and DARCOM to define requirements for a research simulator configured specifically for the study of aviation training problems. An outline concept has been developed which envisions an austere design beginning with an existing Synthetic Flight Training System (SFTS) device. The Flight Simulator Component (FSC) program provides for the development and demonstration of advanced flight simulation techniques and components for incorporation into the design of future simulators or the improvement in training capabilities of current simulators. Full consideration is being given to the accomplishment of the program through cooperative development with Navy and Air Force laboratories. Effort includes the development of visual simulation components designed to provide full training mission capability for NOE flight, navigation, gunnery, and survivability in a hostile environment. Current program includes preliminary design studies for the development of wide-angle, high-resolution, resolution, high pictorial detail visual simulation techniques that provide large frontal and downward angle viewing for NOE flight. Gunnery efforts for training gunnery skills include the development of innovative techniques for multiviewpoint image generation and display for effectively simulating extended range target and sensor images. Technologies include computer image generation (CIG) edge management methodogies for full mission gaming areas.

G. (U) RELATED ACTIVITIES: Program Element 6.42.17.A, Synthetic Flight Training Systems, and 6.22.09.A, Aeronautical Technology. This research and development effort is unique to Army requirements of simulating Nap-of-the-Earth (NOE) visual simulation displays. Coordinated use of Air Force and National Aeronautics and Space Administration (NASA) facilities is accomplished to minimize program costs. The Research and Engineering Division, Project Manager for Training Devices, Naval Training Equipment Center is tasked with responsibility to monitor all related research and development to preclude duplication of effort.

H. (U) WORK PERFORMED BY: The Project Manager, Training Devices, Orlando, FL; Naval Equipment Training Center, Orlando, FL; US Army Research and Technology Laboratories, Ames Research Center, Moffett Field, CA; American Airlines Simulator Engineering, American Airlines Plaza, Fort Worth, TX. Total program control is exercised by the Army Materiel Development and Readiness Command.

Program Element: #6.32.16.A Title: Synthetic Flight Simulators
DOD Mission Area: #552 - Environ & Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Rotorcraft Systems Integration Simulator: Completed preliminary design studies for modifying National Aeronautics and Space Administration (NASA) Vertical Motion System. Installation of CDC 7600 general purpose digital computer which will satisfy computational requirements of Rotorcraft Systems Integration Simulator (RSIS). Flight Simulator Components: one of the two alternative approaches for wide-angle, high-resolution visual display for Nap-of-the-Earth (NOE) application was successfully demonstrated with a monochromatic display. The design and fabrication of the 360° annular display system was essentially completed with demonstration of the technical feasibility of the annular camera probe lens scheduled for 1980. Completed preliminary design studies for a laser scanner visual system that provides for a high-resolution, high-detail visual display.

2. (U) FY 1980 Program: Rotorcraft Systems Integration Simulator: Contract awarded for modifying NASA vertical motion system. Complete preliminary design studies for fabrication of interchangeable rotorcraft cab compatible to NASA's Vertical Motion Simulator.

3. (U) FY 1981 Planned Program: Rotorcraft Systems Integration Simulator: Complete fabrication and initiate installation of an interchangeable rotorcraft simulator cab and augmented motion base. Initiate preliminary design studies for advanced visual system. Motion generator checkout and acceptance from contractor. Flight Simulator component: Initiate design studies for the development and demonstration of dual channel visual simulation system for portraying target scenes at ranges out to five kilometers. Initiate cooperative design studies with Air Force and Navy of multiple-viewpoint visual display system for simultaneous display of targets, sensors, and frontal visual scene in a wide-angle background scene. Initiate preliminary design effort for development of computer image generation (CIG) edge management techniques for visual simulation of extended gaming areas.

4. (U) FY 1982 Planned Program: Rotorcraft Systems Integration Simulator: Complete fabrication of rotorcraft simulator cab, continue motion base modifications and award contract for visual image generator. Aviator Training Research Simulator: Procure computer and integrate with existing cockpit and motion platform. Flight Simulator Components: Complete the fabrication of the dual-channel visual display system and install on the Naval Training and Equipment Center Visual Technology Research Simulator for evaluation. Continue the fabrication of the multiple view point visual display for gunnery and sensor simulation.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #DB34 Title: Rotorcraft Systems Integration Simulator (RSIS)
Program Element: #6.32.16.A Title: Synthetic Flight Simulators
DOD Mission Area: #552 - Environment & Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Demonstration

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The Army, by participating in a joint program with the National Aeronautics and Space Administration (NASA), is developing a highly versatile, high-fidelity, ground-based, rotorcraft simulator to support on-going and future development efforts. The investigation of conceptual designs to include preliminary and detailed designs trade-off, mission capabilities, support of flight test planning, and man-machine/workload evaluations is an essential and analytical tool to Army aviation development. This simulation capability will provide the first real opportunity to accommodate nap-of-the-earth experiments through simulation. Inherent to the simulation will be the capability to analyze specific accident cases for aiding in accident prevention.

B. (U) RELATED ACTIVITIES: This program supports the Army's Aeronautical Technical program (6.22.09.A). The technology being developed in this program also supports programs related to the Navy (6.22.41.N - Aircraft Technology) and the Air Force (6.22.01.F, Flight Dynamics). Duplication of effort is avoided by coordination with these agencies on a continuing basis through: joint program reviews, exchange of technical data and reports, The Technical Cooperation Program (TTCP), NASA research and technology committees, North Atlantic Treaty Organization (NATO) Advisory Group on Aerospace Research and Development (AGARD).

C. (U) WORK PERFORMED BY: This work is managed by the Aeromechanics Laboratory of Moffett Field, California, as part of the US Army Aviation Research and Development Command. Contractors are being competitively selected for both the motion base system and the visual systems as well as providing a uniquely designed interchangeable rotorcraft cab to interface with NASA's Vertical Motion Simulator (VMS).

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: In-house study conducted in early 1975 documented the need for aircraft systems flight simulation in offering an advanced capability, multipurpose, high-confidence simulator. In FY79 contract preparation efforts were undertaken to define scope of work for the motion system compatible with NASA's Vertical Motion Simulator (VMS). The motion generator includes: simultaneous displacements in longitudinal, pitch, roll, and yaw axes; increased payload-carrying capability to accommodate advanced visual system for Army flight profiles (nap-of-the-earth); increased velocity and acceleration performance capability in longitudinal, pitch, roll, and yaw axes; and payload reorientation of 90° for autorotation evaluations.

Project: #DB34
Program Element: #6.32.16.A
DOD Mission Area: #552 - Environment & Life Sciences (ATD)

Title: Rotorcraft Systems Integration Simulator (RSIS)
Title: Synthetic Flight Simulators
Budget Activity: #2 - Advanced Technology Demonstration

2. (U) FY 1980 Program: Continuation of in-house support of project. Contract support initiated for rotorcraft simulator motion generator hardware including system fabrication, delivery, installation, and checkout. Study contract awarded for preliminary design. In-house: Establishment of specification and statement of work supporting request for proposals of the advanced cab and visual system.

3. (U) FY 1981 Planned Program: Continue in-house project support. Continue to support contract for motion generator hardware. Complete contract planning phase for advanced cab and visual system. Award contract for fabrication, delivery, and checkout and integration into NASA's VMS.

4. (U) FY 1982 Planned Program: Motion generator system development completed. Complete the contract development of the advanced cab and visual system. Initiate integrating the rotorcraft simulator motion generator with advanced cab and visual system. Establish planning for simulation operational uses exploring simulation capabilities/limitations.

5. (U) Program to Completion: Complete the integration of advanced cab/visual system to the motion system. Advanced cab development completes in FY83. Initiate and complete the total system checkout. Verify accuracy of simulation facility. Begin Army/VMS scheduling in FY84. Beyond FY 1984, continue the support of Army's share of the VMS operation to include refinements/improvements in simulation efficiency.

6. (U) Major Milestones:

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1980 Submission
Contract Award - Motion System	1QFY1980	Not Shown
Contract Award - Cab/ Visual System	3QFY1980	Not Shown
Motion System Operational	4QFY1982	Not Shown
Cab/Visual System Operation	4QFY1983	Not Shown
Motion/Cab/Visual System Operational	4QFY1984	Not Shown
Full Up Simulation Capability	1QFY1985	Not Shown

Project: #DB34 Title: Rotorcraft Systems Integration Simulator (RSIS)
Program Element: #6.32.16.A Title: Synthetic Flight Simulators
DOD Mission Area: #552 - Environment & Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Demonstration

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	1500	1200	5772	4468	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	400	1200	2050	Not Shown	Continuing	Not Applicable

The difference in FY 1979 ($1,100) and FY 1981 ($3722) reflects a decision to accelerate the program providing a full up simulation capability in FY 1984 vice 1985/1986 timeframe.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.18.A
Title: Airdrop Equipment and Techniques
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	466	1250	2057	2646	Continuing	Not Applicable
D266	Airdrop Equipment & Techniques	466	1250	2057	2646	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports advanced development of airdrop equipment and techniques and responds to documented operational needs (Letters of Agreements and directed actions) for new and improved airdrop operational capabilities. Efforts focused on new airdrop equipment and techniques transition from Program Element 6.22.10.A, Airdrop Technology, to this Program Element for demonstration of technical, operational, and economic feasibility prior to final development and fielding of airdrop equipment. Thus this program element provides a vital and critical link between research and engineering of airdrop equipment and techniques. Airdrop Projects provide systems which are designed to reduce airdrop aircraft vulnerability to enemy air defense, improve operational capability of airborne assault, clandestine, and special operations and provide an essential airdrop resupply capability of both conventional and airborne forces for all Services. All projects are included in the US Army Training and Doctrine Command (TRADOC) priority listing as essential to combat support.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Continue advanced development work of: Ultra-High Level Container System, Airdrop Controlled Exit System, Universal Bundle Airdrop System, and Drop Zone Assembly Aids. Initiate advanced development of Personnel Offset Airdrop System and Heavy Drop Rigging System.

Program Element: #6.32.18.A
DOD Mission Area: #553 - Engineering Technology (ATD)
Title: Airdrop Equipment and Techniques
Budget Activity: #2 - Advanced Technology Development

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	466	1250	2057	Continuing	Not applicable
Funds (as shown in FY 1980 submission)	386	1250	1300	Continuing	Not Applicable

Funding changes reflect a general adjustment in Research and Development programs. The FY 1979 increase was to cover a new task--CTU-2A High Speed Aerial Delivery Container Thruster--and an increase of early testing of the Staged Personnel Parachute System. FY 1980 is unchanged. The increase in funds for FY 1981 is to cover the initiation of Advanced Development of the Personnel Offset Airdrop System, an increase in the scope of work on the Ultra High Level Container Delivery System, and additional operational test quantities for the Airdrop Controlled Exit Systems.

E. (U) OTHER APPROPRIATION FUNDS: ($ in thousands): Not applicable.

Program Element: #6.32.18.A Title: Airdrop Equipment and Techniques
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The work under this program element was formerly under program element 6.32.09.A. Major areas of effort are: The development of a high level cargo airdrop prototype system capable of delivery from an altitude of 7600 meters with an accuracy of 200 meters; the design of a functional prototype system to solve the problem of excessive drop zone dispersion for heavy drop platform loads; identification of alternative advanced concepts for the offset delivery of personnel from high levels and for new heavy drop rigging techniques; development of an airdrop system for the delivery of bundles of equipment and parachutists in a single pass over the drop zone; and the conduct of advanced development of candidate drop zone assembly aids to permit rapid location and identification of airdropped equipment and rapid assembly of airdropped personnel under conditions of low visibility and night.

G. (U) RELATED ACTIVITIES: Program Element 6.22.10.A, Airdrop Technology; Program Element 6.42.18.A, Airdrop Equipment Development; Joint Air Movements Board; Joint Technical Coordinating Group/Airdrop; Mutual Weapons Data Exchange Agreements with France and Germany; North Atlantic Treaty Organization Air Transport Working Party and Air Standardization Coordinating Committee, Working Party 44, Standardization Agreements. International and interservice agreements and boards are used to exchange information on gains in airdrop technology, to avoid duplication of effort through joint and combined efforts, and to promote and attain the objectives of US Rationalization, Standardization and Interoperability (RSI) policies and programs.

H. (U) WORK PERFORMED BY: Payne Inc., Annapolis, MD; AAI Corporation, Baltimore, MD; US Yuma Proving Ground, Yuma, AZ; and US Army Natick Research and Development Command, Natick, MA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Completed certification of CTU/2A Thruster for the High Speed Airdrop Container. Designed and fabricated engineering design test quantities of the Airdrop Controlled Exit System (ACES). Completed first phase of study for Bundle Airdrop System concepts. Transitioned the Staged Personnel Parachute System with Accompanying Bundle to engineering development. Initiated design of the Test Vehicle Recovery System for the Ultra High Level Container Airdrop System (UHLCADS) and procured flight test quantities of Containers.

2. (U) FY 1980 Program: Initiate advanced development of Drop Zone Assembly Aids with emphasis on fielding off-the-shelf or easily adaptable hardware to provide near term improved capability. Conduct engineer design tests and redesign and fabricate final test quantities of Airdrop Controlled Exit System (ACES) for development and operational testing. Continue to develop concepts for the Universal Bundle Airdrop System.

Program Element: #6.32.18.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Airdrop Equipment and Techniques
Budget Activity: #2 - Advanced Technology Development

3. (U) FY 1981 Planned Program: Select candidate(s) near term Drop Zone Assembly Aids, fabricate military potential test quantities and initiate tests with the C-130 Aircraft. Conduct development and operational testing (DTI/OTI) of Airdrop Controlled Exit System (ACES) from C-130 and C-141 Aircraft and transition to engineering development. Select concept(s) for Universal Airdrop Bundle System and procure feasibility test quantities for test from C-130 Aircraft. Procure staging devices, complete design of Test Vehicle Recovery System and conduct engineering design tests of Ultra High Level Container Airdrop System (UHLCADS). Initiate advanced development of Personnel Offset Airdrop Navigation System and Heavy Drop Rigging System. All necessary experimental work will be performed and the preposed system will be ready for full scale development.

4. (U) FY 1982 Planned Program: Continue advanced development of Drop Zone Assembly Aids and Bundle Airdrop System (Universal). Conduct study of fabrication techniques and materials for operational aeroshell for the Ultra High Level Container Airdrop System (UHLCADS). Develop a navigation system for the Personnel Offset Airdrop Navigation System (POANS). Continue design and fabrication of prototype components and systems for Heavy Drop Rigging Systems. Initiate advanced development for Automatic Actuator for Reserve Parachute (Free Fall) and the High Level Platform Airdrop System.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.33.06.A
Title: Terminal Homing Systems
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2908	2970	7806	19337	Continuing	Not Applicable
D236	Terminal Guidance System	2908	2970	5290	16804	Continuing	Not Applicable
D174	8" Guided Projectile	0	0	2516	2533	0	7323

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: To counter Warsaw Pact Forces' numerical superiority, the Army has a need to accurately and economically attack tactical targets and realize the force multiplier effect of terminally guided munitions. This Program Element (PE) provides for development of a terminally guided antiradiation 8-inch artillery projectile (ARP) designed to acquire and home on battlefield radio frequency (RF) emitters such as air defense radars and countermortar/counterartillery radars. The program provides for the development of a passive RF seeker for application to an 8-inch projectile airframe. This PE also encompasses a cooperative effort being carried out for the United States Marine Corps (USMC) to meet their need for an 8-inch semiactive laser guided projectile capable of defeating hard point targets. Follow-on guidance efforts will include development of infrared (IR) and millimeter wave (MMW) seekers for applications to guided projectiles which will have the capability to attack such high-priority targets as tanks and self-propelled artillery.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Continuation of development of an 8-inch antiradiation guided artillery projectile through the scaling down of the US Navy-developed 8-inch extended range guided projectile and applying current radio frequency technology. A limited quantity of prototype rounds will be fabricated for subsequent validation of the extended range glide capability of the projectile. A limited number of radio-frequency (RF) seekers will be fabricated for captive flight and firing tests of the 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) and to survive "high-g" loads during firing. Initiate testing and analysis to determine the accuracy of the seekers and the effectiveness of the warheads.

Program Element: #6.33.06.A Title: Terminal Homing Systems
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	2908	2970	7806	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	4100	9500	3000	Continuing	Not Applicable

This program has been completely restructured since the FY80 budget submission. It reflects the Army's decision to develop a Radio Frequency (RF) seeker for application to an 8-inch airframe concurrent with the continuation of development work for infrared (IR) and millimeter wave (MMW) seekers for application to both 155mm and 8-inch guided projectiles. Funding in FY79 was reduced consistent with the fact that the need and scope of this program were not definitized until February 1979. The FY80 funding was reduced as a result of action taken by the House and Senate Appropriations Committees Joint Conference. The increase in the FY81 funding profile reflects the scope of this program element having been expanded to include development of an 8-inch extended range airframe which will meet the Army requirement with the application of an RF sensor and the Marine Corps requirement with the application of a Semiactive Laser (SAL) seeker. This action was precipitated by tactical/operational considerations which indicated that RF sensing antiradiation projectiles should be fired by 8-inch general support howitzers rather than 155mm direct support howitzers. Efforts in support of developing the 8-inch projectile will be accomplished in project D174 commencing in FY81. The restructured program now calls for an in-house development effort which, as a result or the increased funding in project D236 in FY81, permits the Army to take advantage of technology for the RF sensor developed by the Air Force and Navy in the High Speed Antiradiation Air-to-Surface Missile (HARM) and modifying the already designed Navy 8-inch guided projectile for both Army and USMC use. The advanced development effort is now scheduled for completion and transition to engineering development in FY84.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.33.06.A Title: Terminal Homing Systems
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: A need exists to enhance the capability of field artillery units to passively attack (capability to home on the inherent signature of the target) high-priority targets at greater ranges. This program element provides for two projects. Project D236 supports the examination and initial development of candidate passive homing technologies for application to terminally guided indirect fire munitions. Primary emphasis has been placed on the development of a radio-frequency (RF) seeker with the ability to acquire, discriminate, and track radio-frequency emitters with sufficient accuracy to deliver an explosive warhead and achieve a high probability of single-shot target kill. Targets for this type of engagement are air defense radars, artillery and mortar locating radars, and ground surveillance radars. Extension of the capabilities for the attack of command/control centers will be examined. A secondary effort under this project responds to the Army's need for a terminal homing system capable of acquiring and homing on the electromagnetic signature of tactical targets in the infrared (IR) or millimeter wave (MMW) spectrums. These sensor technologies offer the potential for application to existing (COPPERHEAD) and developmental (Army and Navy 8-inch, Navy 5-inch) guided projectiles and will permit the Army to attack tanks, self-propelled artillery, and other high-priority targets which have these signatures. Project D174 provides for scaling down of the US Navy-developed Extended Range Guided Projectile to meet Army and Marine requirements. The Army application emphasizes the RF sensor and will provide an extended range capability to attack those enemy emitters on the battlefield beyond the current COPPERHEAD range capability and provide a significantly increased lethality over a 155mm round. The USMC application will use a semiactive laser (SAL) seeker and shaped charge warhead to defeat hard-point targets (bunkers, pill boxes).

G. (U) RELATED ACTIVITIES: Joint Development Program for the Army's COPPERHEAD, Program Element (PE) #6.46.21.A, and the Navy's 5-inch, PE #6.46.08.N, semiactive laser guided projectile, and Marine Corps 8-inch, PE# 6.36.35.M, semiactive laser seeker. The Army's position as the Executive Service for development of guided projectiles and coordination with the Navy and Marine Corps development community will preclude duplication of this effort among the Services.

H. (U) WORK PERFORMED BY: In-house work is being performed by: US Army Armament Research and Development Command, Dover, NJ; Electronics Research and Development Command (ERADCOM), Adelphi, MD; US Army Missile Command (MICOM), Huntsville, AL; Naval Surface Weapons Center (NSWC), Dahlgren, VA; and the Naval Weapons Center (NWC), China Lake, CA. Initial contracts for the development of the IR seeker were awarded to General Dynamics, Pomona, CA, and Raytheon, Bedford, MA. Effort under these contracts was completed in FY77.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 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

Program Element: #6.33.06.A Title: Terminal Homing Systems
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

evaluated. This effort was subsequently restructured to provide for greater in-house participation. Contracts for the fabrication and testing of an IR seeker were awarded to Raytheon and General Dynamics and completed in late FY 1977. Evaluation of these IR seekers was conducted in laboratory and captive flight tests by the US Army Missile Command. Both prototypes demonstrated the ability to search, acquire, and track infrared emitters, but the tests also indicated that hardware improvement was required. Preliminary design of the RF sensor, performance specification, and interface definition were completed by the Electronics Research and Development Command and Naval Weapons Center. Funding for this program was temporarily suspended in FY 1978 consistent with the Army's review and assessment of the need. In FY79 the requirement was revised and the program restructured to develop an 8-inch antiradiation projectile (ARP) using the configuration of the projectile proposed by the Naval Surface Weapons Center as the preliminary baseline. Design and fabrication of RF seekers for captive flight and laboratory testing and the design of the 8-inch ARP for aeroballistic firings were initiated.

2. (U) FY 1980 Program: Design and fabrication of radio frequency (RF) seekers for laboratory testing and component testing in a "high-g" environment will be accomplished. A detailed aerodynamic analysis and preparations for wind tunnel testing of the scaled down US Navy-developed 8-inch extended range guided projectile will be made. Detailed warhead lethality analyses and an investigation into special handling devices required for transporting and firing the candidate projectile will be conducted.

3. (U) FY 1981 Planned Program: Fabrication of a limited number of radio frequency seekers for application to the 8-inch guided projectile airframe will be completed. Evaluation, testing, and design of the engineering development baseline configuration will be initiated. Fabrication of the 8-inch guided projectile for flight and warhead testing will be completed.

4. (U) FY 1982 Planned Program: Development Test/Operational Test I (DT/OT I) of prototype projectiles will be initiated. A Special ASARC will be convened to evaluate program progress and testing and approve entry into engineering development following successful flight testing. Development of projectile system design requirements for infrared and millimeter wave sensors will be initiated.

5. (U) Program to Completion: The Artillery Terminal Guidance portion of this PE is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: D236 Title: Terminal Guidance Systems
Program Element: 6.33.06.A Title: Terminal Guidance Systems
DOD Mission Area: #553 - Engineering Technology (ATO) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This project supports the examination and initial development of candidate passive homing technologies for 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 deliver an explosive warhead and achieve a high probability of single-shot target kill. Targets for this type of engagement are air defense radars, artillery and mortar locating radars, and ground surveillance radars. Extension of the capabilities for the attack of command/control centers will be examined. Successful development and application of the sensor to an antiradiation projectile will permit the passive attack of these targets while maintaining maximum commonality with current semiactive laser-guided munitions. This development will fully utilize the results and data of previous and current related efforts--particularly those for antiradiation missiles (ARM), and the Air Defense Suppression Missile (ADSM) and Navy's 8-Inch *Guided Projectile Programs.* A secondary effort in this program will be the adaption of passive infrared (IR) and millimeter wave (MMW) 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 guided projectile.

B. (U) RELATED ACTIVITIES: Joint Development Program for the Army's COPPERHEAD, Program Element (PE) 6.46.21.A; the Navy's 5-Inch PE 6.46.08.N, semiactive laser-guided projectiles and the Marine Corps 8-Inch PE # 6.36.35.M, Semiactive Laser Seeker. The Army's position as Executive Service for the development of these munitions and coordination with the Navy and Marine Corps' development community will preclude duplication of this effort among the Services.

C. (U) WORK PERFORMED BY: In-house work is being performed by: US Army Armaments Research and Development Command, Dover, NJ; Electronics Research and Development Command, Adelphi, MD; US Army Missile Command, Huntsville, AL; Naval Surface Weapons Center, Dahlgren, VA; and the Naval Weapons Center, China Lake, CA. Initial contracts for the development of the IR seeker were awarded to General Dynamics, Pomona, CA, and Raytheon, Bedford, MA. Effort under these contracts was completed in FY77.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 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. This effort was subsequently restructured to provide for government in-house participation; the Anti-radiation Projectile (ARP) sensor performance specification and interface definition were completed. Preliminary design of the sensor

Project: D236 Title: Terminal Guidance Systems
Program Element: 6.33.06.A Title: Terminal Guidance Systems
DOD Mission Area: 7553 - Engineering Technology (ATO) Budget Activity: 02 - Advanced Technology Development

and its subsystem was completed by the Electronics Research and Development Command and the Naval Weapons Center. The configuration of the projectile proposed by the Naval Surface Weapons Center was accepted by the Army as the preliminary baseline. In FY79, the requirement was revised to reflect development of the 8-Inch ARP and the focus on application of the RF seeker.

2. (U) FY 1980 Program: Design and fabrication of radio frequency (RF) seekers for captive flight and laboratory testing and component testing in a "high-g" environment will be accomplished. A detailed aerodynamic analysis and preparations for wind tunnel testing of the scaled down US Navy-developed 8-inch extended range guided projectile will be made. Detailed warhead lethality analysis and an investigation into special handling devices required for transporting and firing the candidate projectile will be conducted.

3. (U) FY 1981 Planned Program: Fabrication of radio frequency (RF) seekers for application to the 8-Inch guided projectile airframe will be initiated. Evaluation, design, and limited testing of an engineering development baseline configuration will be accomplished.

4. (U) FY 1982 Planned Program: Conduct detailed evaluation, demonstration, and testing of RF seekers; initiate IR and MMW sensor efforts; prepare for transition of the program to engineering development following successful flight testing.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Special Army Systems Acquisition Review Council 2Q81.

Project: 0236 Title: Terminal Guidance Systems
Program Element: 6.33.06.A Title: Terminal Guidance Systems
DOD Mission Area: #553 - Engineering Technology (ATO) Budget Activity: #2 - Advanced Technology Development

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	2908	2970	5290	16804	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	4100	9500	3000	N/A	Continuing	Not Applicable

FY 1979 funding was reduced consistent with the fact that the need and scope of this program was not definitized until February of 1979. FY 1980 funding was reduced as a result of action taken by the House and Senate Appropriations Committees Joint Conference. FY 1981 program has been increased consistent with a program restructure and expansion of scope.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.33.14.A
Title: High Energy Laser (HEL) Components
DOD Mission Area: #554 - Directed Energy Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	17292	19000	0	0	Not Applicable	Not Applicable
D093	High Energy Laser (HEL) Components	17292	19000	0	0	-	Not Applicable

B. BRIEF DESCRIPTION OF PROJECT: 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). Advanced Development (AD) prototypes for specific mission applications will be fabricated only after mission viability, system lethality, and technical feasibility have been established. The Army's most stressing potential application is the

C. (U) EXPLANATION OF CANCELLATION OR DEFERRAL: Due to the position of the Army High Energy Laser program in the acquisition cycle, the decision was made in FY80 to emphasize the exploratory development aspects of this high technology program. Consequently, the funds in this program element have been transferred to program element #6.23.07.A. As technology is advanced in future years and becomes suitable for development of a High Energy Laser weapons system, this program element will be reinstated.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.02.A
DOD Mission Area: #553 - Engineering Technology (AD)

Title: Advanced Land Mobility System Concepts
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	15000	15916	12370	11733	Continuing	Not Applicable
D118	Combat Vehicle Technology	2000	1550	4605	11733	Continuing	Not Applicable
D188	High Survivability Test Vehicle	13000	14366	7765	0	0	35131

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The purpose of this program is to develop conceptual and experimental combat testbed vehicles. These conceptual testbed 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 technical feasibility. This program will continue to incorporate components representing new technology into system-oriented developmental vehicles. Continuation of this program will expand the combat vehicle technology base for potential exploitation by the Army. The joint program with the US Marine Corps and the Defense Advanced Research Projects Agency (DARPA) to explore the battlefield utility of lightweight combat vehicles is funded in this program (D188).

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Complete testing and analysis of test results of the High Survivability Test Vehicle-Lightweight (HSTV-L), a small, highly agile armored vehicle weighing 18-22 tons mounting an improved 75mm gun of excellent armor-piercing capabilities and a radically new approach to fire control/acquisition. The High Mobility/Agility (HIMAG) test vehicle, a 33.5-45-ton variable component testbed built to examine the relationship between mobility and survivability will be extensively evaluated in field tests. The HIMAG has a test fixture 75mm gun. User testing is scheduled for completion in 2d Quarter FY81 at Fort Knox, KY, with an extensive test result analysis to follow. These evaluations will provide the data base for future combat vehicles. An elaborate data reduction and analysis program will provide operational and cost effectiveness values for future decisions. Test firings of the 75mm guns from both the HSTV-L and HIMAG vehicles will provide a thorough knowledg of gun, fire control, and vehicle limitations and capabilities. Two test vehicles, the Elevated

Program Element: #6.36.02.A
DOD Mission Area: #553 - Engineering Technology (AD)
Title: Advanced Land Mobility System Concepts
Budget Activity: #2 - Advanced Technology Development

Kinetic Energy (ELKE) Weapon System and the Loopwheel Testbed (LTB) will be fabricated, and contractor testing completed. The ELKE will evaluate the concept of a kinetic energy gun on an elevating mount permitting vehicle and crew to remain in protected defilade while engaging targets. The Loopwheel Testbed (LTB) is a revolutionary application of National Aeronautics and Space Administration (NASA) developed technology to combat vehicles offering a new suspension concept with reduced weight, fewer parts, lower life cycle costs, increased speed and agility, improved ride, and improved damage tolerance. Efforts will be initiated toward a new Tank Testbed Vehicle in order to provide a low-cost means of evaluating advances in tank technology prior to such technology being committed to production-oriented tank programs.

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1980 Submission
Completion of the High Survivability Test Vehicle-Lightweight (HSTV-L) fabrication.	4QFY79	3QFY79
Complete testing of High Mobility/Agility test vehicle (HIMAG) at Ft. Knox, KY.	2QFY81	3QFY80
Complete testing of HSTV-L at Ft. Knox, KY.	2QFY81	3QFY80
Complete fabrication elevated trunnion.	3QFY81	2QFY81
Complete evaluation of elevated kinetic weapon system.	4QFY82	Not Shown
Complete fabrication loopwheel testbed.	2QFY82	2QFY82

(Current milestone dates differ from those shown in FY 1980 Congressional Descriptive Summary because of slippage in completion of fabrication of HSTV-L and in HIMAG and HSTV-L testing.)

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

Program Element: #6.36.02.A
DOD Mission Area: #553 - Engineering Technology (AD)

Title: Advanced Land Mobility System Concepts
Budget Activity: #2 - Advanced Technology Development

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	15000	15916	11733	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	15000	15936	39786	Continuing	Not Applicable

The major change, a reduction in funds for FY81, is due to the deletion of funds previously shown in FY80 for the development of a follow-on vehicle. The funds were deleted in FY81 pending an Army decision on whether to proceed with a follow-on vehicle. The FY80 decrease is the result of a general reduction by Congress.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.36.02.A
DOD Mission Area: #553 - Engineering Technology (AD)

Title: Advanced Land Mobility System Concepts
Budget Activity: #2 - Advanced Technology Development

F. (U) 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 testbed vehicles be fabricated which can be evaluated under actual field conditions. This program encompasses development and evaluation of experimental testbed 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 testbeds 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 gain and maintain superiority over combat vehicles fielded by other countries.

G. (U) RELATED ACTIVITIES: Specific programs related to the technical areas of this program element (PE) are: PE 6.11.02.A, Defense Research Sciences; PE 6.21.05.A, Materials; PE 6.26.01.A, Tank Automotive Technology; 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, Materiels Scale-Up; PE 6.32.01.A, Aircraft Power Plants; PE 6.26.08.A, Tank Gun Development and Tank Ammunition; PE 6.36.21.A, Combat Vehicle Power Trains, and PE 6.36.31.A, Combat Vehicle Turret and Chassis. Close coordination is maintained with other Services and Governmental agencies to preclude duplication of effort. 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 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 US Marine Corps and the Defense Advanced Research Projects Agency (DARPA).

H. (U) 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 are: AAI Corporation, Baltimore, MD; National Water Lift, Kalamazoo, MI; Delco Corporation, Santa Barbara, CA; Hughes Aircraft Corporation, St. Louis, MO; Texas Instruments, Dallas, TX; BDM Corporation, Falls Church, VA; Systems Planning Corporation (SPC), Arlington, VA; Pacific Car and Foundry Co., Renton, WA; and Lockheed Missiles and Space Co., Inc., Huntsville, AL.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

Program Element: #6.36.02.A
DOD Mission Area: #553 - Engineering Technology (AD)

Title: Advanced Land Mobility System Concepts
Budget Activity: #2 - Advanced Technology Development

1. (U) FY 1979 and Prior Accomplishments: Completed fabrication and initiated testing of the High Mobility/Agility (HIMAG) test vehicle. Design studies of lightweight combat vehicle concepts for future consideration were accomplished. Begin design of the Elevated Kinetic Energy Weapon System (ELKE) and the Loopwheel Testbed (LTB). The LTB will evaluate the feasibility of utilizing the loopwheel on combat vehicles in the 10-15-ton range.

2. (U) FY 1980 Program: Complete fabrication and initiate Government testing and evaluation of the High Survivability Test Vehicle - Lightweight (HSTV-L) and the High Mobility/Agility (HIMAG) test vehicle. Testing will continue at Ft. Knox, KY, and Aberdeen Proving Ground, MD, where the 75mm test fixture gun will be fired and evaluated. Analysis of the test data provided by the HIMAG and HSTV-L vehicles will continue. Complete design and initiate fabrication of the Elevated Kinetic Energy (ELKE) Weapon System and Loopwheel Testbed (LTB) utilizing a 10-15-ton testbed chassis.

3. (U) FY 1981 Planned Program: The HSTV-L and HIMAG will complete testing and evaluation, and the program will be completed. Final report on HSTV-L program will be prepared, and recommendations for future light armored vehicles will be provided. Fabrication and contractor testing of the ELKE will be completed. Evaluation of the LTB will start. Initiate design modifications to an XM1 pilot tank for use as a future tank testbed to integrate and evaluate advance technology in such areas as automatic loading, up-powering, external suspension, and fire control.

4. (U) FY 1982 Planned Program: Evaluations will be completed on the ELKE. Performance evaluation of the LTB will continue to define military potential. Detailed design and fabrication of automatic loader and advanced automotive components for tank (XM1 modified) testbed integration will be completed. Initial design studies will commence for a Future Infantry Concept Vehicle compatible for operation in a high-intensity battlefield and having protection equivalent with the XM1 tank and its follow-on versions.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D168 Title: High Survivability Test Vehicle
Program Element: #6.36.02.A Title: Advanced Land Mobility System Concepts
DOD Mission Area: #553 - Engineering Technology (AD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This project is a major element of the Armored Combat Vehicle Technology (ACVT) Program--a program sponsored jointly by the Army, Defense Advanced Research Projects Agency (DARPA), and the Marine Corps. The purpose of the program is to establish the technical, military, and concept feasibility of lightweight armored combat vehicles and medium-caliber antiarmor automatic cannons. The program involves the fabrication, testing and evaluation of test vehicles to reduce reliance on theoretical studies and analyses and to reduce technological risks and uncertainties. As contrasted with the more traditional component development programs, the ACVT Program is strongly oriented toward technology development and applications of technology through the testbed system approach. The ACVT Program consists of the following elements which are being conducted concurrently: (1) fabrication and experimentation with the High Mobility/Agility (HIMAG) testbed vehicle and the High Survivability Test Vehicle - Lightweight (HSTV-L), (2) development of an improved 75mm antiarmor automatic cannon and ammunition to be integrated with the HIMAG and HSTV-L vehicles and fire control systems, (3) parallel Army and Marine Corps analyses to determine experimental employment concepts of candidate weapon system concepts, and (4) analytical and modeling programs to supplement test results and to determine cost-effective options for potential future development. The HIMAG test vehicle is a 33.5- to 45-ton variable parameter testbed mounting the point design 75mm cannon. HIMAG is a highly instrumented rolling laboratory designed to provide extensive data on mobility/agility, rate of fire, fire control systems, human factors, vehicle suspensions, and other areas. The HSTV-L is an 18- to 22-ton testbed, also mounting the 75mm gun, which incorporates new and innovative features for increasing survivability not found on the HIMAG vehicle. The HIMAG and HSTV-L vehicles and the 75mm gun are being tested as integrated systems to generate technical data; they are not being tested to determine whether the systems can meet certain a priori specifications. Key areas being examined and/or exploited in the ACVT Program include: mobility/agility (mechanical, physiological, doctrinal); medium-caliber antiarmor automatic cannons; fully telescoped kinetic energy penetrators; behind-armor effects; level of fire control sophistication vis-a-vis rate of fire, visionics/displays; gun mechanisms, feeders, and loaders; traversable external guns; lightweight high obliquity armors; wheels versus track; doctrine, tactics, and operational effectiveness of candidate armored combat vehicles; reduction of internal vehicle volume; number of crew members; unit and life cycle costs of candidate weapon systems. The ACVT Program will culminate in FY81 with recommendations on appropriate actions to be taken by the Army and Marine Corps concerning the potential for future development of lightweight armored combat vehicles and medium-caliber antiarmor automatic cannons.

B. (U) RELATED ACTIVITIES: Program Elements (PE's): PE 6.26.01.A, Tank and Automotive Technology; PE 6.26.03.A, Large Caliber and Nuclear Technology; PE 6.26.17.A, Small Caliber and Fire Control Technology; PE 6.26.18.A, Ballistics Technology; PE 6.27.09.A, Night Vision Investigations; PE 6.27.16.A, Human Factors in Engineering Systems Development; PE 6.36.21.A, Combat Vehicle Propulsion Systems; PE 6.57.02.A, Support of Development Testing; PE 6.57.06.A, Materiel System Analysis; PE 6.57.04.A,

Project: #D188 Title: High Survivability Test Vehicle
Program Element: #6.36.02.A Title: Advanced Land Mobility System Concepts
DOD Mission Area: #553 - Engineering Technology (AD) Budget Activity: #2 - Advanced Technology Development

US Army Materiel Development and Readiness Command (DARCOM) Ranges/Test Facilities; PE 6.58.04.D, Test and Evaluation (Advanced Antiarmor Vehicle Evaluation); PE 6.36.11.M, Marine Corps Assault Vehicle (Mobile Protected Weapon System). Duplication of effort among these program elements is precluded by close coordination between participants, project officer visits, and consultations, periodic program and budget reviews, and reviews of research and technology work unit summaries.

C. (U) WORK PERFORMED BY: In-house Army organizations participating in the program are: Tank-Automotive Research and Development Command, Warren, MI; Armament Research and Development Command, Dover, NJ; Electronics Research and Development Command, Adelphi, MD; Communications Research and Development Command, Fort Monmouth, NJ; Missile Command, Huntsville, AL; Ballistic Research Laboratory, Aberdeen, MD; Human Engineering Laboratory, Aberdeen, MD; Benet Weapons Laboratory, Watervliet Arsenal, NY: Waterways Experimentation Station, Vicksburg, MS; Army Materiel Systems Analysis Agency, Aberdeen, MD; Armor Center, Fort Knox, KY; Test and Evaluation Command, Aberdeen, MD; Training and Doctrine Command Systems Analysis Activity, White Sands, NM. In-house Navy, Marine Corps, and Air Force organizations are: Naval Postgraduate School, Monterey, CA; Naval Surface Weapons Center, Dahlgren, VA; Marine Corps Development and Education Center, Quantico, VA; US Air Force Military Airlift Command, Scott AFB, IL. Major contractors are: ARES Corporation, Port Clinton, OH; AAI Corporation, Baltimore, MD; National Water Lift Company, Kalamazoo, MI; Texas Instruments, Dallas, TX; DELCO Electronics Corporation, Golita, CA; System Planning Corporation, Arlington, VA; BDM Corporation, Monterey, CA; Raytheon Company, Wayland, MA; AVCO Corporation, Stratford, CN; Detroit Diesel Allison Division of General Motors, Indianapolis, IN; Cadillac Gage Company, Warren, MI; Teledyne Continental Motors, Muskegon, MI; International Laser Systems, Orlando, FL; Martin Marietta Corporation, Orlando, FL; EMR Data Systems Inc., Sarasota, FL; Northrop Corporation, Needham Heights, MA.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: In April 1972, the Army requested that Defense Advanced Research Projects Agency (DARPA) initiate an exploratory development program to assess the feasibility of medium-caliber automatic cannon to be used primarily for defeating armor. This resulted in the DARPA-sponsored 75mm antiarmor automatic gun development contract with ARES Inc. and an associated ammunition contract with AAI Corporation. The 75mm smooth bore cannon is externally powered, automatically fed, and fires in either single-shot or burst-fire modes. The armor-piercing fin-stabilized discarding sabot (APFSDS) round for the 75mm gun is completely telescoped into a very compact composite steel and glass-reinforced cartridge case. Two types of kinetic energy rounds have been developed, both of which make use of new high length-to-diameter ratio fin-stabilized design technology. The APFSDS ammunition has been successfully fired from the ARES gun in both the single-shot and burst-fire modes and has defeated the standard NATO targets. A high-explosive multipurpose round is also being developed. In 1975, the US Army Armor Center requested a high-mobility and -agility (HIMAG) testbed to assess the value of increased

Project: #D188 Title: High Survivability Test Vehicle
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mobility/agility on battlefield survivability. In February 1976, National Water Lift Company, with DELCO as the fire control subcontractor, was selected to design and fabricate the HIMAG system. Teledyne Continental Motors provides the power pack, and ARES Inc. provides the 75mm cannon, loader, and feeder. AAI Corporation provides the ammunition. The HIMAG chassis was completed in early 1978 and shipped to Fort Knox, KY, where it underwent tests to: (1) determine the effects of various chassis-related parameters for achieving high mobility and agility over representative terrains; (2) compare the increase in mobility/agility engineering performance capability of HIMAG configurations to that of conventional combat vehicles; (3) provide indications of the extent to which a crew utilizes the available mobility/agility capability of HIMAG; (4) determine the improvement by HIMAG, for several different evasive maneuvers, in hit avoidance over conventional armored combat vehicles; and (5) provide field test data for the validation/extension of mobile/agility models and analysis. In May 1976, a Letter of Agreement was developed between the Armor and Infantry Centers in collaboration with the Tank-Automative Research and Development Command and the US Marine Corps. It established a need for a testbed to evaluate technology options for lightweight armored combat vehicles in the 16- to 20-ton weight class. In late 1976, AAI Corporation and Pacific Car and Foundry were selected to conduct HSTV-L concept feasibility analyses. The fire control system was to be an integrated hunter-killer type, whereby these two functions could be accomplished independently by two crewmen. In November 1977, AAI Corporation, with Texas Instruments Incorporated as the fire control system subcontractor, was awarded a contract for design and fabrication of HSTV-L. ARES Inc. was to provide the 75mm antiarmor automatic gun, and AAI Inc., the ammunition. AVCO Corporation provided the power pack. Concurrent modeling analytical efforts were conducted to supplement and extend test results. The Army's Armor and Engineer Board was responsible for the design and execution of the HIMAG and HSTV-L tests and associated gun and fire control evaluations and coordinated all activities associated with the experimentation and analyses efforts of the ACVT Program. The Tank-Automotive Research and Development Command refined the Army Mobility Model to include agilitity, provided chassis performance predictions and analyses/extensions of test results, and provided candidate lightweight armored combat configurations for use in vulnerability analyses and cost predictions. The Army's Materiel Systems Analysis Agency determined antitank missile hit probabilities versus highly mobile/agile armored combat vehicles. The Army's Armament Research and Development Command provides technical support to the ACVT Program and is responsible for modifying and improving the methodology for modeling armament performance simulation efforts. The Waterways Experimentation Station provided identification and characterization of test terrain sites. Human factors support to the ACVT Program tests was provided by the Army's Human Engineering Laboratory. The Test and Evaluation Command is responsible for reviewing HIMAG and HSTV-L design, including gun, fire control system, and ammunition, for safety. The Army's Training and Doctrine Command Systems Analysis Activity is conducting operational effectiveness analyses of candidate lightweight armored combat vehicle concepts.

2. (U) FY 1980 Program: The 75mm cannon and ammunition will begin government testing on the High Mobility/Agility (HIMAG) and High Survivability Test Vehicle-Lightweight (HSTV-L) testbed vehicles. These tests are scheduled to begin during

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2QFY80. The results of the experimentation and analysis program will be used as input to Army and Marine Corps decisions regarding the future of lightweight armored combat vehicles and medium-caliber antiarmor automatic cannons (MC-AAAC's). These decisions are scheduled to be made in 4QFY81. The integration of the HIMAG chassis with the gun, turret, and fire control systems has been completed. The test program includes: (1) Surface Target Firepower Performance - performance of selected chassis, fire control system, and gun firing configurations against surface targets; (2) Chassis and Gun System Dynamic Response -- data will be obtained on chassis and gun system dynamic responses during single-shot and burst fire under moving and stationary conditions; (3) Crew Task Evaluation - evaluate crew tasks associated with the HIMAG fire control and gun system; (4) Self-Air Defense Tests - demonstrate the performance of selected combinations of chassis, fire control configurations, and gun firing modes against aerial targets. The HSTV-L chassis has been integrated with the 75mm cannon, turret, and hunter-killer fire control system. Following contractor testing and Product Manager acceptance, the HSTV-L system will start Government testing. The contractor/Government tests are scheduled to commence during 2QFY80. The test program includes: (1) Baseline Firepower and Fire Control system performance against stationary targets from a stationary HSTV-L; (2) Firepower and Fire Control System Performance against a stationary target from a moving HSTV-L and moving targets from a stationary HSTV-L; (3) Tactical Engagements; (4) Mobility/Agility - Technical data on lightweight vehicles (16-20-ton) will be obtained for the tactical mobility/agility data base established with HIMAG. The completion of government testing and analysis is scheduled for 4QFY81. The results derived from the ACVT Program will be presented in a final report. The decision products will include: (1) Hardware potential for use in future systems and/or product improvements of existing systems, (2) Recommendations for development of selected system(s), (3) Recommendations for additional technology efforts, (4) Recommendations to discontinue nonproductive areas of work, (5) Tactical Mobility - Operational data on the mobility of HSTV-L in a tactical scenario will be obtained, (6) Operational data on the visual and aural detectability and acquirability of HSTV-L and the hit-avoidance capabilities of an evasively maneuvering HSTV-L engaged by antitank systems will be obtained.

3. (U) FY 1981 Planned Program: The HIMAG and HSTV-L system tests will be completed at Fort Knox, KY, and if required, a self-air defense demonstration will be conducted at Fort Bliss, TX. The potential operational concepts and associated mission profiles for future lightweight armored combat vehicles (LW-ACU's) will be completed. The operational concepts and weapon system characteristics appropriate for these concepts will be developed from analyses results of mission needs, threat, environment, potential organization, tactics, doctrine, mission profiles, costs, and the technical data base. From these operational concepts and weapon system characteristics, a set of conceptual hardware configurations representing future LW-ACV's will be developed. These configurations will be described in sufficient detail to allow performance, effectiveness, vulnerability, and cost estimates to be made. The methodology to be used in producing the preferred set of conceptual LW-ACV's comprises: (1) An analytical evaluation of system and subsystem performance and effectiveness in an operational context, to include modeling at both the small unit and force-on-force level; (2) The results of tests conducted as part of the ACVT

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program; (3) The results of an analysis of associated issues, e.g., technical risk assessment, strategic mobility, RAM-D, ancillary equipment, integrated logistics support, force structure trade-off, command and control, etc.; (4) The results of cost analysis. The criterion of choice in identifying the preferred operational concepts and systems and/or subsystems, if any, for potential further development will be the increase in force effectiveness, tempered by considerations of cost, technical risk, strategic and tactical mobility, force procurement costs and force structure impact. The completion of Government testing and analyses is scheduled for 4QFY81. The results derived from the ACVT Program will be presented in a final report. The decision products will include: (1) Hardware potential for use in future systems and/or product improvements of existing systems, (2) Recommendations for development of selected system(s), (3) Recommendations for additional technology efforts, (4) Recommendations to discontinue nonproductive areas of work.

4. (U) FY 1982 Planned Program: Not Applicable.

5. (U) Program to Completion: Program completed in FY81.

6. (U) Major Milestones:

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1980 Submission
Contract award for HSTV-L fabrication	1Q FY78	2Q FY78
Testing of HIMAG at Fort Knox, KY; Aberdeen Proving Ground, MD; and Ft Bliss, TX	2Q FY81	4Q FY80
Complete fabrication of HSTV-L	4Q FY79	4Q FY79
Begin testing of HSTV-L	2QFY80	1Q FY80
Complete testing of HSTV-L	2Q FY81	4Q FY80
Interim report completed	4QFY81	1Q FY81

Current milestone dates differ from those shown in the FY 1980 Congressional Descriptive Summary because of slippage in HIMAG and HSTV-L testing.

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7. (U) Resources ($ in thousands):

RDTE	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
Funds (current requirements)	13000	14366	7765	0	0	35131
Funds (as shown in FY 1980 submission)	10000	14376	37686	Continuing	Continuing	Not Applicable

(Difference in funding for FY 1979 represents a Congressional transfer of funds from Project 6.36.02 D305 to this project. Difference in funding profiles between the FY 1981 and the FY 1980 Congressional Descriptive Summaries in FY81 reflects HIMAG and HSTV-L test slippages and the decision to remove the FY 1981 anticipated funding supporting the future development of lightweight armored combat vehicle.)

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.06.A Title: Landmine Warfare/Barrier Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4313	5165	5205	9985	Continuing	Not Applicable
D006	Landmine Warfare Development	3000	2306	1868	4742	Continuing	Not Applicable
D608	Countermine & Bar Development	1313	2859	3337	5243	Continuing	Not Applicable

B. (U) 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 urban 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 to allow for greater battlefield mobility of friendly troops, an off-route antitank mine for use along highways and roads and in urban terrain, and a river mine to enhance the obstacle potential of watercourses. Identified components, when integrated, will provide a system of mines and delivery means meeting Army requirements. Soviet and WARSAW PACT doctrine advocates the large scale use of landmines in both offensive and defensive operations. In support of this doctrine, the Soviets have developed mechanized devices which rapidly lay minefields having a variety of complex mine fuzes. Mutually supporting countermine devices and techniques are required to meet the threat. This program element also improves the Army countermine capabilities by investigating and exploiting materials, techniques, and equipment evolving from exploratory development. These investigations will ultimately lead to enhanced tactical mobility by neutralizing the barrier potential of enemy minefields. Also, improved field fortifications techniques are devised and evaluated to improve battlefield survivability of friendly forces by hardening tactical positions.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Continue efforts on: improved lethal mechanisms, counter-countermeasure components, increased area mine system components, target signature analysis, controllable minefield components, and analysis of systems effectiveness; an improved fuel air explosive mine neutralization system and a dedicated counter obstacle vehicle as long range efforts to counter the minefield threat; and a family of improved tactical shelters.

Program Element: #6.36.06.A Title: Landmine Warfare/Barrier Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	4314	5165	5205	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	6714	5181	8930	Continuing	Not Applicable

In FY 1980 submission, project D608, Countermine & Barrier Development, this profile was shown in Program Element 6.36.18.A/D608. The FY 1979 and FY 1981 decreases for both projects reflect movement of funds to higher priority Army requirements. The FY80 decrease is the result of a general Congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.36.06.A Title: Landmine Warfare/Barrier Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) 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 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 to provide truly controllable barriers, highly lethal to enemy forces, while harmless to friendly troops. Also, 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. Detection thrust has transitioned from the meticulous point-to-point search to methods of detecting minefields from standoff locations. Neutralization has been redirected from a slow defuzing 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 being 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.

G. (U) RELATED ACTIVITIES: Exploratory development for this program is conducted in Program Elements 6.26.03.A, Large Caliber and Nuclear Technology, and 6.27.33.A, Mobility Equipment Technology. Systems advanced development for landmine warfare/barrier systems is performed in Program Element 6.36.19.A, Landmine/Barrier Systems. Engineering development of items and concepts in this program is performed in Program Elements 6.46.12.A, Countermine & Barriers, and 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, Mines, and Clusters to avoid duplication of effort. The Department of Defense Armaments Munitions Requirements and Development Committee monitors the scatterable mine program with a view towards avoiding Service duplication. Countermine efforts are closely coordinated with the Development Project Office for Selected Ammunition, Dover, NJ, who is responsible for the Army Mine Program.

H. (U) WORK PERFORMED BY: The Development Project Office for Selected Ammunition, US Army Armament Research and Development Command (ARRADCOM), Dover, NJ; is responsible for management of Landmine Warfare systems and components. The US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA, is assigned responsibility for Countermine and Barriers. 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.

Program Element: #6.36.06.A Title: Landmine Warfare/Barrier Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 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 successfully 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 controllable mine systems. Design work on improved power sources and influence sensors were conducted with excellent results. A prototype command and control module for scatterable mines were developed. During FY 1977, efforts were initiated on a microprocessor for mine sensor logic to assist in target discrimination and to 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. During FY 1978, efforts continued on a microprocessor for mine sensor logic and on counter-countermeasures for antitank sensors. Work was initiated on improved lethal mechanisms and off-route mine components. 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 successfully 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. Work was initiated on a portable projected line charge for antipersonnel minefields and hardening of vehicle components to resist mine damage.

2. (U) FY 1980 Program: Complete development of a microprocessor for mine sensor logic and anti-mine hardened vehicle components. Continue development efforts on improved lethal mechanisms, counter-countermeasure components, increased area mine system components, target signature analysis, controllable minefield components, mine sensor components, analysis of systems effectiveness, improved fuel-air explosives and an improved tactical shelter.

3. (U) FY 1981 Planned Program: Continue efforts on improved lethal mechanisms, counter-countermeasures components, target signature analysis, controllable minefield components, and analysis of systems effectiveness. Complete component development for increased area mine and mine sensor components. Initiate efforts on components for mines for use in urban terrain. Complete advanced technology efforts on improved fuel-air explosives. Continue advanced development on a dedicated counter obstable vehicle and a family of improved tactical shelters.

4. (U) FY 1982 Planned Program: Continue efforts on counter-countermeasure components, target signature analysis, systems effectiveness, and urban terrain mines. Complete efforts on improved lethal mechanisms and controllable minefield components. Continue efforts on improved countermine, barrier, and field fortification concepts, techniques, and components.

Program Element: #6.36.06.A Title: Landmine Warfare/Barrier Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.13.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Advanced Fuze Design
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1175	1571	0	0	0	12227
DE55	Advanced Artillery and Mortar Fuzing	1175	1000	0	0	0	11376
DE59	Supporting Advanced Fuze Development	0	571	0	0	0	851

B. (U) BRIEF DESCRIPTION OF PROJECT: This program provided for the advanced development of fuzing and fuzing componentry for artillery, mortar, aerial rockets and tank ammunition. The primary goal has been to increase operational utility (lethality, reliability, flexibility) of present munitions as well as improve mission cost-effectiveness. New technologies have been applied to improve existing components such as impact switches, safety and arming devices and power supplies used in all standard artillery and tank ammunition fuzes. The program also encompassed efforts aimed at improving techniques for testing fuzes and monitoring their operations, thereby reducing development time and cost.

C. (U) EXPLANATION OF CANCELLATION OR DEFERRAL: This program has been eliminated. Work formerly conducted in project DE55 is now accomplished in PE 6.36.28.A for artillery fuze advanced development and will be accomplished in 6.36.33.A for future tank fuze advanced developments. Project DE59 has been deferred because of low funding priority.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.21.A
Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 - Engineering Technology
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5350	3811	11547	22700	Continuing	Not Applicable
DG07	Combat Vehicle Engine	3850	2511	6222	17510	Continuing	Not Applicable
D395	Combat Vehicle Transmission	1500	1300	5325	5190	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for advanced technology demonstration of combat vehicle propulsion components. Due to extreme operational requirements engine systems intended for military use should possess high output, low volume and weight, multifuel capability, efficiency and durability not normally available on the commercial market. Ancillary components, such as air filtration and cooling systems, must be provided to enable these systems to operate in a unique military environment. This program also provides funding to develop combat vehicle transmissions necessary to provide greater vehicle efficiency and responsiveness for increased survivability and performance.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Continue advanced development of the adiabatic engine to provide a fuel efficient, alternate fuel capability, compact and lightweight engine for the lightweight class (20-30 Ton) of combat vehicles. Complete the development effort of the components for fuel economy improvements of the AGT-1500 turbine and conduct integrated confirmatory tests. Continue the effort on developing efficient self-cleaning air cleaners for high output turbines and diesels. Development of the compact, efficient 1000 HP diesel (AD1000) will be continued for the mid-range weight class of vehicles (30-45 Tons). Continue development, including completion of prototype fabrication, of the CVX-650 hydromechanical transmission for the lightweight class of vehicles. Design of the AMX 1000 hydrokinetic transmission will also be completed, providing a modern transmission for the mid-range weight class of combat vehicles.

Program Element: #6.36.21.A
DOD Mission Area: #553 - Engineering Technology

Title: Combat Vehicle Propulsion Systems
Budget Activity: #2 - Advanced Technology Development

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1980 Submission
Complete Laboratory Testing of 1st Adiabatic Demonstrator Engine	4QFY 1981	4QFY 1981
Complete Fabrication of Initial CVX650 Transmission	4QFY 1981	4QFY 1981
Begin Testing of CVX650	1QFY 1982	1QFY 1982
Complete Assembly of 1st Prototype Fuel Efficient AGT-1500 Gas Turbine*	4QFY 1980	2QFY 1980

*Delay due to late start of design efforts and late deliveries of long leadtime items.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5350	3811	11547	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	5700	3816	7000	Continuing	Not Applicable

FY79 difference is due to reprogramming of funds to higher priority programs. The decrease reflected in FY80 is the result of a general Congressional reduction. The increase in FY81 is due to accelerated development of the AD1000 engine for Project DG07 and AMX-1000 transmission for Project D395.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.36.21.A
DOD Mission Area: #553 - Engineering Technology

Title: Combat Vehicle Propulsion Systems
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: To be effective, ground combat vehicles must be able to move rapidly with a high degree of reliability. The unique operational requirements of combat vehicles often dictate that propulsion systems and other components be developed under government auspices. To ensure that such components are available for integration into present and future ground combat vehicles, vehicle power train components are developed within this program. The program's goals are to develop those components that will: (1) increase fuel tolerance; (2) improve fuel economy; (3) improve horsepower-to-ton ratio; (4) improve compactness; (5) improve reliability, availibility, maintainability, and durability; and (6) improve control and driveability.

G. (U) RELATED ACTIVITIES: Program Elements (PE): PE 6.26.01.A, Tank and Automotive Technology; PE 6.36.02.A, Advanced Land Mobility Systems Concepts; PE 6.21.05.A, Materials; PE 6.27.33.A, Mobility Equipment Technology; PE 6.32.01.A, Aircraft Power Plants and Propulsion; PE 6.31.09, Fuels and Lubricates Advanced Development; PE 6.31.02.A, Materials Scaleup; and PE 6.36.26 Advanced Diesel Engine Technology. Foreign state-of-the-art trends in military propulsion systems are constantly monitored by the Tank-Automotive Research and Development Command, and data is exchanged with allied countries via data exchange agreements. Inter/Intra-Service/Department duplication of effort is prevented through active planning and coordination of this program at all levels of organization. Program content is subject to continuous review.

H. (U) WORK PERFORMED BY: United States 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; AVCO Lycoming, Stratford, CT; Donaldson Corporation, Minneapolis, MN; Cummins Engine Company, Columbus, IN; Detroit Diesel Allison, Indianapolis, IN; General Electric, Pittsfield, MA; and FMC Corp, San Jose, CA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: A contract was awarded for a 1500 hp advanced diesel program (AVCR-1360) in accordance with guidance provided by Congress. This program provides for engine design improvements including development of a variable area turbocharger and the development of a modulated cooling fan system. Work continued on AGT-1500 gas turbine engine fuel economy improvement. Design, fabrication, and initial testing of a self-cleaning air filter system was completed; analysis has led to a decision to proceed into fabrication of a preproduction version. Development of a hydraulic pump, motor, and electronic controls for the CVX-650 transmission was conducted. Initial concept and design studies were conducted to identify parameters for a 1000 hp transmission (AMX-1000) for application in combat vehicles in the 30-45 ton weight class. A 1000 HP Advanced Diesel (AD 1000) Program was initiated.

2. (U) FY 1980 Program: Advanced development of an experimental prototype adiabatic engine for the light weight class of combat vehicles will be initiated. Component rig testing of the AGT-1500 turbine fuel economy modifications will be completed

Program Element: #6.36.21.A Title: Combat Vehicle Propulsion Systems
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and assembly of two complete engines for performance demonstration and endurance testing will be initiated. Fabrication of preproduction versions of self-cleaning air filters will be completed and bench testing, as well as vehicle installation for field testing, will be conducted. The CVX-650 transmission development will continue into its second year; controls will be finalized, and fabrication of critical components preparatory to preliminary bench testing will be completed.

3. (U) FY 1981 Planned Program: Continue advanced development of the prototype adiabatic engine including dynamometer testing of components and detail design. Complete the AGT-1500 Fuel Economy Program with laboratory validation testing. Design completion and initiation of fabrication of the AD1000 diesel engine will take place. Based on successful prior tests, self-cleaning air cleaners will be fabricated for additional applications and units fabricated for vehicle and laboratory tests. The CVX-650 hydromechanical transmission effort will complete component tests and fabrication of two prototype units. The AMX1000 transmission program will include completion of the design and processing of long lead time hardware orders.

4. (U) FY 1982 Planned Program: Advanced development of the adiabatic engine with fabrication of prototype engines will continue. Initiation of advanced air filtration development for turbine engines is planned utilizing new extend life dust separation techniques. Development of a new turbine engine with reduced air and fuel requirements will begin. Dynamometer and vehicle tests of the CVX-650 Transmission will near completion during this year. AMX1000 transmission prototype fabrication will be completed and laboratory tests started. The AD1000 diesel prototypes will be assembled and subjected to laboratory tests. Installation of an AD1000/AMX1000 package into a testbed vehicle is also planned.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #DG07 Title: Combat Vehicle Engines
Program Element: #6.36.21.A Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 Engineering Technology Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: Effective ground combat vehicles must be able to move rapidly with a high degree of reliability. This program provides for the technology demonstration of those combat vehicle engines not commercially available. The unique operational requirements of combat vehicles often dictate that engines and other components be developed under government auspices. To ensure that such components are available for integration into future and present ground combat vehicles, vehicle engines are developed within this program. The program's goals are to develop for future combat vehicles those components that will: (1) increase fuel tolerance; (2) improve fuel economy; (3) improve horsepower-per-ton ratio; (4) improve compactness; and (5) improve reliability, availability, maintainability, and durability (RAM-D).

B. (U) RELATED ACTIVITIES: Program Elements (PE): PE 6.26.01.A, Tank and Automotive Technology; PE 6.36.02.A, Advanced Land Mobility Systems concepts; PE 6.21.05.A, Materials; PE 6.27.33.A, Mobility Equipment Technology; PE 6.32.01.A, Aircraft Power Plants and Propulsion; PE 6.31.09, Fuels and Lubricants Advanced Development; PE 6.31.02.A, Materials Scaleup; and PE 6.36.26, Advanced Diesel Engine Technology. Foreign state-of-the-art trends in military propulsion systems are constantly monitored by the Tank-Automotive Research and Development Command, and data is exchanged with allied countries via data exchange agreements. Inter/Intra-Service Department duplication of effort is prevented through active planning and coordination of this project at all levels of organization. Project content is subject to continuous review.

C. (U) WORK PERFORMED BY: United States (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; AVCO Lycoming, Stratford, CT; Donaldson Corporation, Minneapolis, MN; Cummins Engine Company, Columbus, IN.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Efforts were initiated to develop a 1000 HP Advanced Diesel Engine (AD1000) which specifically includes low specific weight and volume, excellent response for high mobility and agility, excellent fuel economy and performance, and very low acquisition cost compared to a completely new military version engine. A 3-year, incrementally funded contract was negotiated to perform the first phase of this development. Preliminary analysis and design of the basic reciprocator unit has been completed, and a test rig engine to be used to develop the final basic reciprocator unit has been fabricated. On 30 Mar 79, in consonance with Congressional guidance, a contract to continue development of a 1500-HP diesel engine (AVCR-1360) was signed with Teledyne Continental Motors (TCM) as the prime contractor. Work encompasses three phases of activity on the AVCR-1360 engine: (1) Variable Area Turbocharger (VAT) incorporation, (2) Variable cooling fan use,

Project: #DG07 Title: Combat Vehicle Engines
Program Element: #6.36.21.A Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 Engineering Technology Budget Activity: #2 - Advanced Technology Development

and (3) XM1 vehicle installation study. Preliminary design and analysis has begun. AGT-1500 Fuel Economy Program: In FY 1979, four new recuperator core module concepts were generated for test comparison with existing modules. Testing started July 1978. Layouts of both power turbine wheels plus the second stage nozzle were completed. Final design work is being accomplished on the combustor scroll and liner. Self-Cleaning Air Filter: fabrication of the self-cleaning prototype model is complete; testing is continuing into the high capacity dust phase.

2. (U) FY 1980 Program: The Adiabatic Engine Program will be initiated in FY80: The Adiabatic Engine Program activity plans include multicylinder feasibility engine demonstration, advanced component development, and ceramic material and turbomachinery improvements. Engine demonstration is scheduled to include a minimum of 250 hours of operation during which a fuel consumption decrease of over current diesel engine is expected. Advanced component development includes ceramic material and design improvements in various engine areas including monolithic pistons and liners, and the development of advanced turbomachinery mechanisms. AD1000 efforts include: (1) extensive test rig engine operation and development, (2) fabrication and building of the first advanced 1000 HP diesel engine, utilizing advanced turbomachinery and turbocompounding, and (3) testing of this engine. AGT-1500 Fuel Economy Program: testing of engine continues with increased turbine inlet temperature and improved component efficiencies. The 10% decrease in fuel consumption achieved in this program will be translated into increased range or decreased fuel requirements for a given mission distance. Self-Cleaning Air Filter: Continue testing and evaluation of latest design turbine air cleaner; incorporate redesign indicated and initiate additional new approaches.

3. (U) FY 1981 Planned Program: Adiabatic Engine effort will: (1) continue advanced component development, (2) continue test and optimization using the multicylinder feasibility adiabatic engine as a testbed, (3) design, procure, fabricate, build and test two experimental prototype adiabatic engines, (4) design and procure long-leadtime items for ten advanced prototype adiabatic engines. AD1000: Design will be completed and fabrication of prototype demonstrators for the self-propelled vehicle program will be initiated. AGT-1500: The engine, with modifications, will be installed in a vehicle and field tested. This program will demonstrate a 10% improvement in brake specific fuel consumption. Self-Cleaning Air Filter: Test and evaluation of improved design turbine air cleaners with design scaling for additional applications will continue.

4. (U) FY 1982 Planned Program: Adiabatic Engine effort will: (1) complete procurement, fabrication, and build of advanced prototype engines, (2) begin extensive dynamometer performance test of advanced prototype engines, and (3) begin design study for vehicle test rig installation. AD1000 effort will include: (1) completion of procurement, fabrication, and dynamometer testing of three feasibility demonstrator engines, (2) initial fabrication of advanced prototype engine and (3) installation into a vehicle test rig. An Advanced Turbine Engine candidate for the XM1 follow-on vehicle will start development. This engine will employ advanced cycle techniques to reduce volume, air and fuel requirements. At the completion

Project: #DG07 — Title: Combat Vehicle Engines
Program Element: #6.36.21.A — Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 Engineering Technology — Budget Activity: #2 - Advanced Technology Development

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	3850	2511	6222		Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	4900	2516	5000		Continuing	Not Applicable

FY79 differences are due to reprogramming funds to higher priority programs. The decrease in FY80 is the result of a general Congressional reduction. The increase in FY 1981 is to provide for accelerated development of the AD-1000 Engine required for the mid-range weight class of combat vehicles.

Project: #DG07 Title: Combat Vehicle Engines
Program Element: #6.36.21.A Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 Engineering Technology Budget Activity: #2 - Advanced Technology Development

of development, the engine will have major increases in performance, with prime emphasis on low fuel consumption in the 20% to 40% range, increased specific power and lower acquisition cost. Self-Cleaning Air Filter: continue test and evaluation of improved design turbine air cleaner. This air cleaner will have extended periods of time between servicing requirements resulting from the use of new dust separation techniques.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones:

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1980 Submission
Complete Laboratory Testing of 1st Adiabatic Demonstrator Engine	4QFY 1981	4QFY 1981
Complete Assembly of 1st Prototype Fuel Efficient AGT-1500 Gas Turbine*	4QFY 1980	2QFY 1980
Complete Assembly of 1st Prototype AD-1000 Engine	3QFY 1982	Not Shown

* A more extensive design effort than originally planned delayed AGT 1500 Fuel Economy Program; additionally, receipt of long lead items has been delayed.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D395 Title: Combat Vehicle Transmissions
Program Element: #6.36.21.A Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 Engineering Technology Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This program provides for advanced technology development of vehicle transmissions and steer systems not existing in the commercial market. Combat vehicles require transmissions which not only convert engine output to vehicle needs but also provide vehicle steering and service and parking brakes. The increased vehicle performance demanded for modern combat vehicles dictates increased power capacity, improved steering control and substantial service brake improvements. This program will provide for combat vehicles transmissions with reduced weight and volume, increased efficiency, improved reliability and maintainability, and directional control and driveability improvements.

B. (U) RELATED ACTIVITIES: Program Elements (PE): PE 6.26.01.A, Tank and Automotive Technology; PE 6.36.02.A, Advanced Land Mobility Systems Components; PE 6.21.05.A, Materials; PE 6.27.33.A, Mobility Equipment Technology; and PE 6.31.02.A, Materials Scaleup. Foreign state-of-the-art trends in military propulsion systems are constantly monitored by the Tank-Automotive Research and Development Command, and data is exchanged with allied countries via data exchange agreements. Inter/Intra-Service/Department duplication of effort is prevented through active planning and coordination of this project at all levels of organization. Project is subject to continuous review.

C. (U) WORK PERFORMED BY: United States (US) Army Tank-Automotive Research and Development Command, Warren, MI, is responsible for the development of this program. Major contractors are: Detroit Diesel Allison, Indianapolis, IN; General Electric, Pittsfield, MA; and FMC Corporation, San Jose, CA.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: The CVX 650 Hydromechanical Transmission is being developed for vehicles of up to 25 tons powered by engines in the 600-750 horsepower range. CVX 650: The AMX 1000 Hydrokinetic Transmission is being developed for vehicles in the 30-45 ton weight class with engines of 750 to 1000 horsepower. Award of a four-year development contract was made to General Motors. Accomplishments included the completion of layout work and the design of critical transmission components and control components. AMX 1000: A concept and feasibility study was initiated during the last quarter of FY79. Preliminary performance specifications have been established along with a 6-speed design concept with the same number of parts as the current 4-speed.

2. (U) FY 1980 Program: CVX 650: Design of the transmission system as well as the electronic control units and shift selector is scheduled for completion. Also, it is planned to initiate all and complete most of the fabrication of the

Project: #D395 Title: Combat Vehicle Transmissions
Program Element: #6.36.21.A Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 Engineering Technology Budget Activity: #2 - Advanced Technology Development

transmission and controller hardware. The testing during this fiscal year will consist of evaluation of all the critical components, the electronic controller and the electronic controlled hydrostatic subsystems. AMX 1000: The design will be completed as will the major portion of the component testing. Assembly of two transmissions will be initiated.

3. (U) FY 1981 Planned Program: CVX 650: The fabrication and assembly of two prototype transmissions will be completed. The shakedown, spin, and performance tests will be initiated in the laboratory. A vehicle will be modified for installation of the transmission. AMX 1000: The design and major portion of the component testing will be completed. Assembly of two transmissions will be initiated.

4. (U) FY 1982 Planned Program: CVX 650: This fiscal year will be the final phase of this development program. Laboratory performance and durability will be performed. Simultaneously, in-vehicle performance testing will occur. AMX 1000: Laboratory performance testing and vehicle modification for transmission installation will be initiated.

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones:

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1980 Submission
Complete fabrication of initial CVX 650 transmission	4QFY 1981	4QFY 1981
Begin testing of CVX 650	1QFY 1982	1QFY 1982
Complete fabrication of AMX 1000 transmission	4QFY 1982	Not Shown
Begin testing of AMX 1000	4QFY 1982	Not Shown

Project: #D395 Title: Combat Vehicle Transmissions
Program Element: #6.36.21.A Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 Engineering Technology Budget Activity: #2 - Advanced Technology Development

7. (U) Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1500	1300	5325	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	700	1300	2000	Continuing	Not Applicable

FY79 difference is attri utable to the CVX650; contracting efforts revealed that development fire and cost could be curtailed by increasing initial-year funding. FY81 difference reflects acceleration of the AMX 1000 transmission for use in the mid-range weight class combat vehicles.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.31.A
DOD Mission Area: #533 - Engineering Technology

Title: Combat Vehicle Turret and Chassis
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2565	3732	5877	13977	Continuing	Not Applicable
D014	Combat Vehicle Hull & Turret	0	2132	3868	9797	Continuing	Not Applicable
D424	Combat Vehicle Track & Suspension	2565	1600	2009	4180	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for advanced technical demonstration of components associated with the ground combat vehicle hull, turret, track, and suspension subsystems; such subsystems are militarily unique, in general, and therefore must be developed through US Army research and development.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: The development of automatic optical fire detection and suppression systems enters the final phase with the conduct of explosive vehicle fire performance tests. Development will continue on the Advanced Techniques for Electrical Power System (ATEPS) prototype hardware for a tank feasibility demonstration. Effort will be initiated to develop a state-of-the-art target acquisition/fire control system for integration into the next generation of combat vehicles; effort will include detailed analysis of all combat vehicle interfaces with fire control such as stabilization, chassis/suspension effects, etc. Fabrication of lightweight class and heavy-weight class track will be completed and testing will begin. Independent external suspension development will transition from exploratory development to advanced development. The detection and countermeasure of Soviet Antitank Guided Missile (ATGM) threats will be integrated on a ground combat vehicle. The Countermeasure (CM) Optimization Program will continue to assess the cost effectiveness of detection and CM hardware against Soviet threats to ground combat vehicles.

Program Element: #6.36.31.A
DOD Mission Area: #533 - Engineering Technology

Title: Combat Vehicle Turret and Chassis
Budget Activity: #2 - Advanced Technology Development

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1980 Submission
Fire Detection and Suppression*		
System - Start Testing	2QFY80	4QFY79
Complete Testing	2QFY81	2QFY80
Advanced Techniques for**		
Electrical Power Systems - Start Testing	3QFY80	1QFY81
Advanced Fire Control -***		
Initiate Design	2QFY81	3QFY80
Complete Design	3QFY83	4QFY82
Advanced Track****		
Initiate RAM-D testing of Advanced Track	2QFY81	3QFY79
Complete RAM-D testing of Advanced Track	1QFY82	2QFY80
Countermeasures		
Demonstration of vehicle integrated threat detection and CM system	2QFY81	None Shown
Demonstration of acoustically based detection of threats to armor	4QFY81	None Shown

*Start of testing delayed by ex ended contract negotiation. Completion date extended to allow for increased scope of testing.
**Increased priority of project resulted in diverting of resources to hasten initiation of testing.
***Design initiation and completion delayed by redistribution of priorities within the project.
****Delays due to extended contract negotiations.

AD-A082 155 DEPUTY CHIEF OF STAFF FOR RESEARCH DEVELOPMENT AND AC--ETC F/G 15/5
DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS OF THE RESEARCH, DEV--ETC(U)
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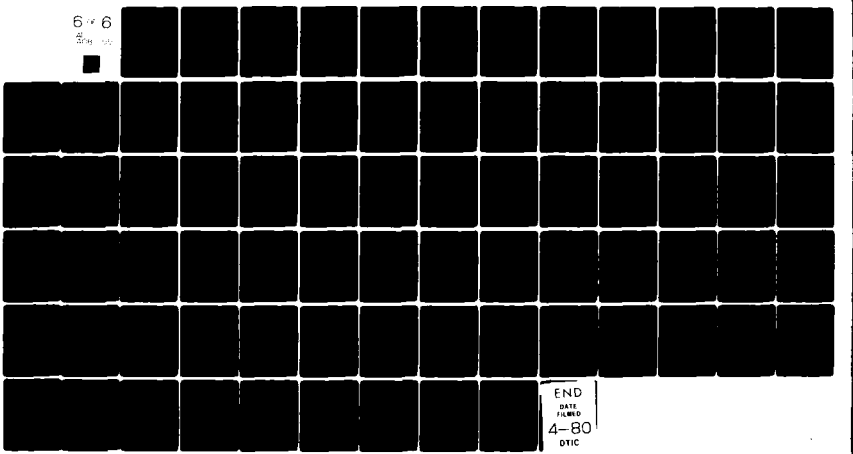

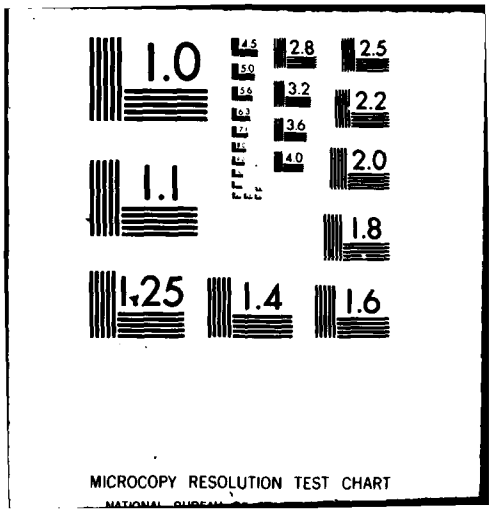
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MICROCOPY RESOLUTION TEST CHART

Program Element: #6.36.31.A
DOD Mission Area: #533 - Engineering Technology

Title: Combat Vehicle Turret and Chassis
Budget Activity: #2 - Advanced Technology Development

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	2565	3732	5877	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	351	3732	8557	Continuing	Not Applicable

FY 1979 increase due to increased scope in advanced track (D424) and initiation of fire survivability and automatic defense efforts (D014). FY 1981 decreased due to deletion of planned initiatives in advanced composite materials, prototype armor, mine protection, and combination armor (D014).

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.36.31.A Title: Combat Vehicle Turret and Chassis
DOD Mission Area: #533 - Engineering Technology Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program supports efforts in: (1) fire detection and suppression system; (2) consolidation of electrical power management, integration of fire control system; (3) improved track and suspension design; and (4) the incorporation of countermeasures and defense mechanism against air- and ground-launched threats to ground combat vehicles. Automatic fire detection and suppression is being developed to extinguish explosive fires in milliseconds, minimizing vehicle damage and troop casualties. Fire control effort is intended to more rapidly service targets. Track and suspension effort is aimed primarily at cost reduction. Countermeasure effort is intended to improve crew/vehicle survivability.

G. (U) RELATED ACTIVITIES: Program Elements (PE): PE 6.21.05.A, Materials; PE 6.31.02.A, Materials Scaleup; PE 6.21.20.A, Nuclear Weapons Effects/Fluidics; PE 6.26.01.A, Tank Automotive Technology; PE 6.36.02.A, Advanced Land Mobility Systems Concepts; PE 6.26.17.A, Small Caliber and Fire Control Technology; PE 6.27.02.A, Night Vision Investigations; PE 6.27.16.A, Human Factors in Military Systems; and PE 6.26.18.A, Ballistics Technology. Foreign state-of-the-art trends in military propulsion systems are closely monitored, and technology information is exchanged with allied countries via data exchange agreements. Close coordination and continuous discussion with other Services/Departments preclude duplication of efforts. Joint programs are also being pursued with the United States Air Force and the US Navy to adapt techniques used for the reduction of aircraft and missile vulnerability to ground combat vehicle use.

H. (U) WORK PERFORMED BY: The Army Tank-Automotive Research and Development Command, Warren, MI, is responsible for the development and system integration of this program. Major contractors for the program elements include Chrysler, Huntsville Electronics Division, Huntsville, AL; System Consultants, Incorporated, Dayton, OH; Santa Barbara Research Center, Goleta, CA; Marotta Scientific Controls, Incorporated, Boonton, NJ; Graviner Incorporated, Mountainside, NJ; HTL, Monrovia, CA; FAA, Atlantic City, NJ; FMC, San Jose, CA; National Water Lift Company, Kalamazoo, MI; Chrysler Corporation, Detroit, MI; Standard Products Company, Port Clinton, OH; Goodyear Tire and Rubber Company, St. Mary's OH; Firestone, Noblesville, ID; Northrop Corporation, Anaheim, CA; Honeywell Corporation, Minneapolis, MN; and Martin-Marietta Corporation, Orlando, FL.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Prototype hardware and laboratory test fixtures for the fire detection and suppression program were fabricated. The fabrication of an Advanced Techniques for Electrical Power System (ATEPS) prototype hardware for tank application was initiated. ATEPS will eliminate the cumbersone, unrealiable wiring harness and replace it with a reliable state-of-the-art multiplexed system. Analyses of prototype tracks for light- and medium-weight combat vehicles were initiated.

Program Element: #6.36.31.A
DOD Mission Area: #533 - Engineering Technology

Title: Combat Vehicle Turret and Chassis
Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1980 Program: Conduct laboratory performance and environmental tests on fire detection and suppression components. Revise and update specifications. Continue to develop Advanced Techniques for Electrical Power System (ATEPS) prototype hardware for the tank. Fabricate prototype tracks for evaluation on the M113 family of armored personnel carriers, and M60 and XM1. Initiate modification of aircraft self-protection systems for application to combat vehicles. Develop, apply, and evaluate passive countermeasures for suppression of combat vehicles infrared, millimeter (MM) wave/radar and acoustic signatures.

3. (U) FY 1981 Planned Program: Conduct explosive fire field tests to validate specifications and demonstrate the goal of extinguishing a fire within 100 milliseconds; finalize and release military specifications. Complete development of Advanced Techniques for Electrical Power Systems (ATEPS) turret prototype hardware and conduct vehicle tests. This will provide a multiplexed, high-reliability wiring harness replacement for combat vehicles. Accelerate selected high potential fire control technologies and initiate definition of specific fire control components for a demonstratable target acquisition/fire control system. Conduct field evaluation of prototype track; fabricate fluidic controlled dampers to provide better ride quality, greater mobility, and improved reliability; initiate field evaluation phase of vehicle hardening track with a goal of surviving a 22-pound mine blast; and evaluate independent external suspension to increase cross-country speed and to make maintenance easier, at the same time increasing usable hull volume. Integrate accoustically based detection hardware and modified aircraft self-protection hardware into ground combat vehicle; assess survivability enhancement. Continue development and application of passive infrared, millimeter wave/radar and acoustic countermeasures.

4. (U) FY 1982 Planned Program: Continue effort in the Advanced Techniques for Electrical Power Supply (ATEPS). Continue to integrate fire control technologies being developed by various commands into a prototype target acquisition fire control system. Initiate field evaluation of fluidic dampers and fabricate prototype vehicle hardening and independent external suspension systems.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.02.A
Title: Electric Power Sources
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	3557	5055	4348	8731	Continuing	Not Applicable
	QUANTITIES						
DG10	Advanced Tactical Power Sources	1790	861	1715	1692	Continuing	Not Applicable
DG11	Advanced Electrical Energy Sources	1767	4194	2633	7039	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: A continuing need exists to upgrade electric power sources for Army tactical 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 for digital computer systems that cannot be met with existing items in inventory. 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 10kW power range, have low power efficiencies, are noisy, provide heat (infrared) signatures, easily detected by enemy surveillance, require excessive maintenance and are not fuel economical. Present batteries and low-power sources for various communications and electronics hardware have short shelf lives, are undependable, and are temperature sensitive. This program provides for the necessary development of battery power sources designed to satisfy the tactical and logistic requirements for long unactivated shelf life, high energy density, continuous long-life operation and high-performance capabilities. This program provides the necessary technologies required to develop improved electromechanical power sources with emphasis on equipment with greater mobility, higher efficiency, reduced fuel consumption, common components, improved reliability, noise and heat signature reduction, and multifuel and/or non-fossil-fuel capability.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Funding is required to provide for the capability to operate batteries in cold environments, high Gravity (G) environments, and at higher power densities. Initiate development of direct current to direct

Program Element: #6.37.02.A
Title: Electric Power Sources
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 Advanced Technology Development

current (DC to DC) voltage converters to supply multiple precision voltages to digital equipment in communications-electronics systems. Complete methanol fuel cell component effort in 3.0 and 5.0 kW capacities for the family of silent, lightweight tactical power sources. Continue efforts on ceramic components to increase power output and fuel efficiency of gas turbine generators by allowing the turbine to operate at higher temperatures. Continue development of various power conditioning devices to provide required type and quality of power from multiple sources.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	3557	5055	4348	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	4535	5055	5711	Continuing	Not Applicable

The FY 1979 budget difference indicates a slowdown in the start of the planned effort to develop a family of power conditioners in project DG11 and the difference in FY 1981 also reflects a slowdown in the level of effort to develop this family of power conditioners.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.37.02.A Title: Electric Power Sources
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) 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 associated 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 types of 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.

G. (U) RELATED ACTIVITIES: In order to preclude a duplication of effort, 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.

H. (U) 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, Chicago, IL; Energy Research Corporation, Bethel, CT; United Technology Corporation, Hartford, CT; Delco Electronics Division of General Motors, Goleta, GA; Solar Division of International Harvester, San Diego, CA; Mallory Battery Company, Terrytown, NY; and TRW, Incorporated, Redondo Beach, CA.

Program Element: #6.37.02.A Title: Electric Power Sources
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Development of lithium sulfur dioxide batteries with properly electrochemically balanced cells and thermal cut-off devices for safe, reliable performance provided improved sources of power for moderately high-rate use in portable equipment. Performance of the lithium cell was extended to application in night vision and other devices requiring high energy input. Low-resistance polyolefin separator materials were successfully evaluated in nickel-cadmium aircraft batteries for suitability at all temperatures and to overcome thermal runaway, particularly at high temperatures. A standardized model of a 3.2 kW alternating current to direct current precision voltage converter for digital circuits was developed. Efforts were continued to develop ceramic components to improve high-temperature performance of small-size gas turbine engines suitable for Army generators. Ceramic nozzle vanes for gas turbine engines successfully completed dust erosion, thermal shock, salt spray, and cyclic endurance testing. Full ceramic nozzle assemblies successfully operated in the 10 kW gas turbine generator over a wide range of loads for 200 hours. Performance and endurance testing of hot pressed silicon nitride ball bearings verified projected potential for significant increase in bearing life, heat generation, and preload requirements compared to the M50 tool steel ball bearings currently used. Initial evaluation of a 5.0 kW Stirling engine generator set was completed. The 15 kW power conditioner breadboard model was evaluated for reliability, availability, and maintainability (RAM); and electrical performance data; and a prototype unit was fabricated. The Advanced Development (AD) power inverter for the 1.5 kW fuel cell was completed, and AD is continuing on the 3.0 kW and 5.0 kW fuel cell sizes.

2. (U) FY 1980 Planned Program: The lithium battery system will be developed into a flat cell structure for artillery- and air-delivered sensors and jammers--these cells will be capable of withstanding the high-spin and high-shock environments encountered during deployment. Complete AD and confirm feasibility of 2.5 kW DC to DC converter/regulator for digital equipment precision power subsystem, and a 500-watt thermoelectric power source designed to meet Silent Lightweight Electric Energy Plant (SLEEP) Required Operational Capability (ROC) requirements. Testing of prototype acoustical components to silence the 10kW gas turbine generator set will be completed, and AD of 3.0 and 5.0 kW fuel cell inverters will be continued. The design and fabrication of ceramic hot section static components will be initiated for uprating of the 10 kW gas turbine to 15 kW. Initial ceramic heat recovery components will be designed and fabricated for low specific fuel consumption (SFC) gas turbines. AD will continue on the 3.0 kW & 5.0 kW methanol fuel cell components.

3. (U) FY 1981 Planned Program: Initial designs of second-generation lithium cells will be incorporated into battery designs for evaluation of high power levels required in designator and Night Vision (NV) observation equipment. High-Gravity (Hi-G) lithium flat cells will be evaluated in Hi-G environment. Initiate AD of end voltage DC to DC converter to supply multiple precision voltages to digital equipment in communications-electronics systems. Continue fabrication of components for

Program Element: #6.37.02.A Title: Electric Power Sources
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

testing of 15 kW ceramic uprated gas turbine engine. Continue evaluation of heat recovery components for low SFC gas turbine engines. Complete investigation of a high-temperature turbine rotor. Continue 3.0 kW and 5.0 kW methanol fuel cell development program and demonstrate 1.5 kW size hydrocarbon fuel conditioner subsystem to allow for fuel cell operation on present logistic fuels. Advanced Development of the 15 kW power conditioner will continue.

4. (U) FY 1982 Planned Program: Second-generation lithium battery designs will be developed that have increased energy density to 50 percent more than first-generation lithium batteries, and also provide higher power capacities. Lithium flat cell structures will be incorporated into battery designs and subjected to high stress of artillery and air-dropped equipment. Initiate AD of a DC-AC inverter for the precision power subsystem for supplying emergency AC power for digital systems to prevent loss of data in the event of power failure. Contract award is planned for fabrication of AD models. Complete Advanced Development of DC to DC precise end voltage converters for digital circuits to confirm feasibility. Complete performance demonstration of static hot section and heat recovery components to establish optimum design for 15 kW demonstrator low-Specific Fuel Consumption improved power density gas turbine. Complete the 3.0 kW and 5.0 kW methanol fuel cell AD program. Initiate work on 1.5 kW hydrocarbon fuel power unit. Advanced Development will be completed on the 15 kW power conditioner, and work will be initiated on other members of the family of power conditioners.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element #6.37.09.A

Title: Advanced Technology Demonstration of Test Measurement, Diagnostic Equipment (TMDE)

DOD Mission Area: #244 - Mobility and Logistics Technology Demonstration

Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	0	1205	1211	Continuing	Not Applicable
D633	Advanced Test Equipment Technology	0	0	1205	1211	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Dramatic advance in semiconductor and computer technologies have allowed the development of more complex military 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, stimulators and simpler automatic test program generation systems must be developed to keep pace with this new and highly complex semiconducter technology. The new and emerging technologies in electronics and electro-optics (such as Very Large Scale Integrated (VLSI) circuits, Very High Speed Integrated (VHSI) circuits, micro-processors, integrated electro-optics, fiber optics, surface wave and charge-coupled devices, etc) which will appear in prime equipment, in the 1980's making testing of these weapon systems even more critical. The objective of this program is to insure the design of a prime weapon system for testability, including built-in-test, failure prediction and fault tolerance. It will also provide demonstration models and techniques to diagnose faults and/or operational defects accurately, quickly and at the level of repair/-replacement that assures minimum equipment teardown.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: To develop and demonstrate the capability of the AN/USM 410 automatic test system to provide stimuli and measurement functions for multi-test station applications. Successful development of this capability will allow two or more units under test to be tested simultaneously thus dramatically increasing the workload capability of the general support ATE supporting the myriad of command, control communications, electronic warfare and aviation equipment. In an effort to reduce ATE test program validation costs, software stimulation techniques will be utilized to stimulate ATE for missile and communications systems. This effort offers a high probability of providing a lower cost alternative of test program development.

Program Element #6.37.09.A

Title: Advanced Technology Demonstration of Test Measurement, Diagnostic Equipment (TMDE)

DOD Mission Area: #244 - Mobility and Logistics Technology Demonstration

Budget Activity: #2 - Advanced Technology Development

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1980 Submission
AN/USM-410 Multi-Station Demo		
Contract Award	1st Quarter FY81	Not Shown
Contract Completion	1st Quarter FY82	Not Shown
AN/USM-410 Simulator		
Contract Award	1st Quarter FY81	Not Shown
Contract Completion	1st Quarter FY82	Not Shown

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	0	0	1205	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	0	700	1700	Continuing	Not Applicable

The decrease in FY 1981 from prior Congressional submission is due to the reprogramming to higher priority program. FY 1980 funds were deleted by Congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: ($ in thousands): Not Applicable.

Program Element #6.37.09.A

Title: Advanced Technology Demonstration of Test Measurement, Diagnostic Equipment (TMDE)

DOD Mission Area: #244 - Mobility and Logistics Technology Demonstration

Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The new and emerging technologies in electronics and electro-optics (such as Very Large Scale Integrated (VLSI) circuits, Very High Speed Integrated (VHSI) circuits, micro-processors, integrated electro-optics, fiber optics, surface wave and charge-coupled devices, etc.) which will appear in prime equipments in the 1980's will make testing of these weapon systems even more critical. The objectives of this program are to (1) insure the design of prime weapon systems for testability, including built-in-test, failure prediction and fault tolerance, (2) provide demonstration models and techniques to diagnose faults and/or operational defects accurately, quickly and at the level of repair/replacement that assures minimum equipment teardown, (3) determine the nature of repair, (4) provide complete repair information and (5) demonstrate methods and techniques to reduce costs of test measurement and diagnostic equipment through more efficient use of available automatic test hardware.

G. (U) RELATED ACTIVITIES: Program elements 6.27.45.A, TMDE Technology, and 6.47.46.A, Engineering Development Automatic Test Equipment, accomplish the exploratory and engineering development work, respectively, for work covered under this element. Coordination is achieved with other government agencies through the Joint US Army Materiel Development and Readiness (DARCOM), Naval Materiel Command (NMC), Air Force Logistics Command (AFLC), Air Force Systems Command (AFSC) Logistics Commanders Panel on Automatic Testing. This Panel generates policies and procedures to be applied DoD-wide to optimize definition, application and support of automatic testing hardware and software in the systems acquisition management process. Also, it coordinates within the Services the R&D planning and execution of the testing program to minimize duplication of effort and produce a coherent program directed toward achieving common objectives. It does this by assessing the technical program, goals, and potential pay-off from a tri-service total investment of testing technology funds. Participation with the Industry/Joint Services Automatic Test Project is also accomplished to establish liaison and review outputs to maximize the outputs of this program for cost effective operation of tri-service weapon systems.

H. (U) WORK PERFORMED BY: The in-house and contract monitoring work will be performed by the US Army Communications Research and Development Command, Fort Monmouth, New Jersey. There is no existing contractual effort because of the lack of FY80 funding.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Prior work was covered under Program Element (PE) PE 6.36.22.A, Project AJ29. It was under Program Element 6.37.07.A/D244 that the existing AN/USM-410 automatic test system was developed and under PE 6.36.22.A/AJ29 that the early Automatic Test Support System (ATSS) program was initiated and established. The AN/USM-410 is an

Program Element #6.37.09.A

Title: Advanced Technology Demonstration of Test Measurement, Diagnostic Equipment (TMDE)

DOD Mission Area: #244 - Mobility and Logistics Technology Demonstration

Budget Activity: #2 - Advanced Technology Development

automatic test system for electronic systems and is used to perform functional and diagnostic testing of Army electronic materiel. The advanced development of the AN/USM-410 Automatic Test System was completed in support of Advanced Attack Helicopter and Signal Intelligence/Electronic Warfare systems.

2. (U) FY 1980 Program: No funds are anticipated for this fiscal year.

3. (U) FY 1981 Planned Program:

(a) (U) AN/USM-420 Multi-Station Demo: The objective of this program is to develop and demonstrate the capability of the AN/USM-410 to provide stimuli and measurement functions for multi-test station applications. The development of this capability will increase the AN/USM-410 system flexibility and throughput by allowing two or more Units-Under-Test (UUT's) to be simultaneously tested. This effort has a high probability of dramatically increasing the workload capability of the Army's only general purpose automatic test equipment supporting maintenance in the field of a myriad of communications, command and control electronic warfare and aviation equipment.

(b) (U) AN/USM-410 Simulator: To reduce Automatic test equipment test program validation costs, software simulation techniques will be utilized to simulate the AN/USM-410 on an off-line computer so that a larger percentage of the test program validation can be accomplished off-line. Also, interface design and checkout modules will be provided to automate the test adapter and wiring interface requirements. A demonstration of the simulator will be conducted to validate the program against several Units-Under-Test. This effort has a high probability of providing the Army with a significantly lower cost alternative of test program development than that presently used by a multitude of weapon system developers; e.g., Advanced Attack Helicopter, Fighting Vehicle System, etc.

(c) (U) ATEMS Simulator: To reduce test program validation costs, software simulation techniques will be utilized to simulate the automatic test equipment for missile systems (ATEMS) on an off-line computer to decrease the on-line system validation effort during the development of the test program sets. This effort has a similar probability of high payoff for numerous missile system developers; e.g., General Support Rocket System, the TOW subsystem on FVS, etc.

4. (U) FY 1982 Planned Program:

(a) (U) AN/USM-410 Multi-Station Demo: This is a continuation of the FY81 program to demonstrate the capability of the

Program Element #6.37.09.A

Title: Advanced Technology Demonstration of Test Measurement, Diagnostic Equipment (TMDE)

DOD Mission Area: #244 - Mobility and Logistics Technology Demonstration

Budget Activity: #2 - Advanced Technology Development

AN/USM-410 stimuli and measurement functions for the Multi-test Station applications. Test station versatility and test throughput will be featured.

(b) (U) ATEMS Multi-Station Demo: The objective of this program is to develop and demonstrate the capability of time sharing the ATEMS stimuli and measurement functions for multi-test station applications to increase the throughput of ATEMS.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics & Physical Science (ED) Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	10177	13951	21815	30262	Continuing	Not Applicable
DK70	Night Vision Advanced Development	10177	8660	13733	18505	Continuing	Not Applicable
DK86	Night Vision Airborne Systems	0	2276	3464	4572	Continuing	Not Applicable
DK87	Night Vision Combat Vehicles	0	3015	4618	7185	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army needs an improved capability to fight at night and during periods of limited visibility. The pinpoint accuracy and massive firepower currently available are valueless unless targets can be acquired, identified, and accurately located. The objective of this program continues to be to apply recent advances in technology to reduce the life cycle costs and improve the performance of night sights to provide the Army with the necessary improved night and limited visibility fighting ability. This improved performance will effectively multiply US ground combat power. With this capability, the Army will be able to successfully counter a foe who plans and trains to continue operations during all visibility conditions. The night vision and electro-optics systems developed are used by the individual soldier, missile systems, helicopters, and combat vehicles. While the current common module Forward Looking Infrared (MOD FLIR) systems can and do provide extremely high performance for surveillance, target acquisition, and fire control, the technology places a severe limitation on the size and weight below which manportable thermal sights may not be reduced. Fielding over 20,000 systems with less size, weight, and cost than the current devices will allow the Army to meet and counter the threat. To reduce the time of target acquisition, identification, and engagement, while increasing survivability and the accuracy of fire control for both aircraft and combat vehicles, will require development and integration of new technology. A critical portion of this technology is the implementation of counter-countermeasures to all methods whereby the fire control systems can be rendered ineffective. This program bridges the gap between the efforts of Night Vision Investigations (PE 6.27.09.A) and Night Vision Devices (PE 6.47.10.A).

Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics & Physical Science (ED) Budget Activity: #2 - Advanced Technology Development

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Development within thermal technology will concentrate on prototypes of second-generation manportable thermal imaging systems for individual and crew-served weapons with less than one-half the size, weight, and cost of present systems. This same far infrared technology will be applied to a tank driver's viewer. In addition, prototypes of CO_2 laser rangefinders and millimeter wave radars will be fabricated and evaluated for combat vehicle applications.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	10177	13951	21815	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	8437	14017	22472	Continuing	Not Applicable

The increase in FY 1979 was for thermal weapon sights ($1225) and forward looking infrared Cobra TOW ($515). The decrease in FY 1980 is the result of a general congressional reduction. The decrease in FY 1981 was due to program realignment and higher priority projects.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics & Physical Science (ED) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Far infrared capability represents a first order improvement over image intensification technologies in that systems made using infrared are light-level independent, exhibit dust, smoke, and fog penetration, and allow for rapid acquisition of targets. The Night Vision & Electro-Optics Laboratory development of Army Forward-Looking Infrared (FLIR) Common Modules has made this technology affordable for the Army; systems for antiarmor and tank applications are now in production. Packaging and integration efforts must still be undertaken to permit infrared capability to be incorporated into combat vehicle driving devices. The application of infrared technology to devices for the individual soldier is not possible with the current technology. Devices of sufficient compactness and lightness are possible only through the use of thermoelectrically cooled 3 to 5 micron Second generation FLIR technology, now in development in the technology base. These devices, thermal weapon sights, include the Infrared Rifle Sight, the Long-Range Weapon Sight for crew-served applications and a surveillance capability for the infantry commander. In addition, the use of this technology will be investigated as an independent sight for the combat vehicle commander. The commander is currently constrained to share a sight with the tank gunner, thus eliminating the possibility of employing the hunter-killer tactical concept. Under extremely adverse weather conditions, wherever FLIR's are ineffective, it may be possible to secure tactical superiority through the use of millimeter wave radar. A prototype device is being configured for testing to determine the utility of this approach. At the present time, laser range-finders are adversely affected by adverse atmospheric conditions that are invisible to infrared sights. A CO_2 laser range-finder will solve this problem. Such a device will be integrated with a tank thermal sight during this period.

G. (U) RELATED ACTIVITIES: The Army's Night Vision Laboratory has been assigned the responsibility for coordination of all night vision technology based programs within the three Services to avoid duplication and to insure that maximum use is made of resources and capabilities within the Department of Defense (DOD) community. Additionally, active international technical interchange is maintained with National Atlantic Treaty Organization (NATO) through Panel VI (Combat Intelligence) of the NATO Army Armaments Group (NAAG). The Federal Republic of Germany Memorandum of Understanding (MOU) for the sale and coproduction of the DOD Standardized Common Modules is being executed. Germany's plan to use Common Modules on their LEOPARD I & II, MARDER, and LUCHS vehicles is a significant step forward in NATO standardization for Thermal Imaging Systems. Negotiations are in progress within NATO on an MOU for sale and coproduction of common modules with Italy and the Netherlands. Development of an all weather capability for the Army Remotely Piloted Vehicle is funded under program element 6.37.25.B, Remotely Piloted Vehicles.

H. (U) WORK PERFORMED BY: Work is performed by the United States Army Night Vision and Electro-Optics 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, Incorporated, Dallas, TX; Aeronutronics Ford Corporation, Newport Beach, CA; and Hughes Aircraft, Culver City, CA.

Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics & Physical Science (ED) Budget Activity: #2 - Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Tubes for low cost Night Vision Aids were developed and tested, and contracts awarded for fabrication of the aids (goggles) using these tubes. Improvement to the 1st generation of Infrared Common Modules have been completed. These improvements provide increased durability and maintainability. The battery powered cooler for the Night Observation Device, Long Range (NODLR) was developed. A neodymium laser rejection filter for image intensifier was developed. Prototypes of Third generation Pilot's Night Vision Goggles were flight tested.

2. (U) FY 1980 Program: The Advanced Development design will be completed for both high sensitivity and low cost 3rd generation tubes to transition to full scale development. In addition, the Force Development Test and In-Process Review of the Low Cost Night Vision Aids using these tubes will be completed. A program on infrared jammer sources will be initiated. Airborne flight test will be conducted of COBRA helicopter with thermal imaging common modules to provide night and limited visibility capability with TOW antitank missiles mounted on aircraft. Advanced Development of the Thermal Driver's Viewer will be initiated.

3. (U) FY 1981 Planned Program: Using advanced technologies for the Second Generation 3-5 micron thermoelectrically cooled systems, a family of high performance thermal imaging systems for the individual soldier will enter advanced development. Prototype development of millimeter wave radar systems will demonstrate integration with tank Forward Looking Infared Sights. Development of a prototype system for the tank commander will be initiated. Advanced Development of the CO_2 laser for combat vehicles will be completed. Advanced Development for the Thermal Driver's Viewer will be completed.

Personnel utilized: Professional 64, Support 57.

4. (U) FY 1982 Planned Program: Advanced Development of the 2nd generation Thermal Weapon Sights will be completed. Millimeter wave radar for combat vehicles will be evaluated and a determination made as to how to proceed with a tank all-weather system. Work will begin on a prototype for a long range surveillance system. Prototype development will begin on a common module retrofit to 1st Generation FLIR's to allow substantial improvement in poor weather performance and to allow automation (auto-cueing and auto-tracking).

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #DK70 Title: Night Vision Advanced Development
Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics and Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The Army has the need for a cost-effective ability to fight during periods of darkness and limited visibility with a relative combat capability that equals that during daylight. This project applies new techniques, components, and devices to produce significant cost reductions and performance improvements for night vision devices to meet that need. The combat capability is required to counter the threat of a foe that plans to continue combat operations during periods of darkness and limited visibility. The objective of this project is the advanced development of night vision components and devices which have applications independent of specific weapons systems or vehicles. This is the base project for the program element and includes infrared laser, and image intensification technologies.

B. (U) RELATED ACTIVITIES: Related Projects are Program Element 6.37.10.A, project DK86, Night Vision Airborne Systems, and Program Element 6.37.10.A, Project DK87, Night Vision Combat Vehicles. These latter projects were established to increase management visibility of specific applications. The Army's Night Vision and Electro-Optics Laboratory has been assigned the responsibility to coordinate all night vision technology based programs within the three Services to insure maximum use is made of resources and capabilities within the Department of Defense (DOD). Active international technical interchange is maintained within National Atlantic Treaty Organization (NATO) Army Armaments Group (NAAG). Configuration control is maintained for common modules produced for United States systems as well as those produced under the Memorandum of Understanding with the Federal Republic of Germany.

C. (U) WORK PERFORMED BY: Work is performed by the United States Army Night Vision and Electro-Optics 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, Dallas, TX; and Hughes Aircraft, Culver City, CA.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Second Generation Image Intensifier tubes and devices have been developed, tested, and are in production. First Generation Infrared Common Modules have been standardized within the three Services and are in production for such items as the AN/TAS-4, TOW Night Sight; and AN/VSG-2, Tank Thermal Sight. High sensitivity 3rd generation Image Intensification Tubes have been fabricated and given limited field testing. Low cost Night Vision Aid Tubes have been fabricated. The performance qualification of 1st generation infrared common module competitive sources has been

Project: #DK70 Title: Night Vision Advanced Development
Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics and Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

completed. The fabrication of 2nd generation infrared common modules was initiated. A neodymium base rejection filter for image intensifiers was demonstrated. A battery powered closed cycle cooler for manportable thermal sights was developed to replace the current compressed gas powered cooler.

2. (U) FY 1980 Program: Advanced Development design will be completed for both high sensitivity and low cost 3rd generation image intensification tubes which will transition to full scale development. In addition, the Force Development Test and In-Process Review of the Low Cost Night Vision Aids using these tubes will be completed. A program on infrared jammer sources will be initiated. Advanced development of a Mini-Rangefinder will be completed.

3. (U) FY 1981 Planned Program: Using advanced technologies for the 2nd Generation 3-5 micron thermoelectrically cooled systems, a family of high performance thermal imaging systems for the individual soldier will enter advanced development. These devices, known as thermal weapon sights, will include the Infrared Rifle Sight, the Long Range Weapon Sight for Crew Served applications, and a surveillance capability for the infantry commander. The capability thus to the individual soldier represents a first order improvement over currently fielded technologies in that systems made using far infrared are light level independent, provide dust, smoke, and fog penetration and allow for rapid acquisition and engagement of targets.

4. (U) FY 1982 Planned Program: Advanced Development of the Thermal Weapon Systems will be completed. Work will begin on a prototype for a long range surveillance system. Prototype development will begin on a common module retrofit to 1st Generation Forward Looking Infrared Systems to allow substantial improvement in poor weather performance and to allow automation (auto-cueing and auto-tracking).

5. (U) Program to Completion: This is a continuing program.

6. (U) Major Milestones: Not Applicable

7. (U) Resources ($ in thousands):

Project: #DK70 Title: Night Vision Advanced Development
Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics and Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	10117	8660	13733	18505	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	8437	8660	14472		Continuing	Not Applicable

The increase in FY 1979 was for Thermal Weapons Sights ($1225) and Forward Looking Infared COBRA TOW ($515). The decrease in FY 1981 is due to reordering of priorities and tasks within Program Element 6.37.10.A.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.25.A Title: Remotely Piloted Vehicle (RPV's)/Drones
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Tech Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT QUANTITIES	1891	3329	5266	5744	Continuing	Not Applicable
DK61	Remotely Piloted Vehicles/ Drones	1891	3329	5266	5744	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides an Advanced Development base for improvements to the Target Acquisition Aerial Reconnaissance (TADAR) RPV being developed under Program Element (PE) 6.47.30.A and for the development of additional RPV mission capabilities other than TADAR. RPV's are required to 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. Projected improvements to the TADAR system include night/adverse weather sensors utilizing Forward Looking Infra-Red (FLIR) and Millimeter Radar technology, improved command control techniques such as multiple air vehicle control from a common ground station and extended range data links, survivability simulations and testing, and laser rangefinder/designator troop safety improvements. Additional mission capabilities include communications and noncommunications jammers, weather sensor, communications relay platforms, radiac survey and decoy.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: RPV sensor developments will continue with heavy emphasis on developing a night/adverse weather sensor capability for mini-RPV applications. The United Kingdom (UK) Remotely Piloted Helicopter effort will continue to be monitored in an effort to take advantage of mutual requirements in propulsion, command and control, sensor and survivability techniques through the US/UK Memorandum of Understanding. Eye-Safe Laser technology is expected to transition from PE 6.27.32.A for further development leading to an eye-safe laser rangefinder to permit realistic training without compromising troop safety. A contract will be initiated to define the interface of extended range capability and multiple control to the Modular Integrated Communications and Navigation System (MICN's) and the RPV program.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

Program Element: #6.37.25.A Title: Remotely Piloted Vehicle (RPV's)/Drones
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Tech Development

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1891	3329	5266	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	2191	3496	3413	Continuing	Not Applicable

Reduction in FY79 is due to funds being reprogrammed to satisfy immediate requirement for the Integrated Avionics Control System program under Program Element 6.32.07, Aircraft Avionics Equipment. FY81 estimate was increased to place emphasis on night/limited adverse weather sensor capability. FY80 decrease is the result of a general congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: ($ in thousands). Not Applicable.

Program Element: #6.37.25.A Title: Remotely Piloted Vehicle (RPV's)/Drones
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Tech Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of the Army RPV program is to field a series of lightweight, small-sized RPV's that operate in a tactical environment to accomplish a broad range of mission capabilities. Initial efforts are oriented on the early fielding of an RPV with daylight television and laser designator/rangefinder to meet the need for target acquisition, adjustment of artillery fire, laser target designation and reconnaissance beyond the forward edge of the battle area (FEBA) and past the range of ground observers. Follow-on efforts are oriented at providing this system with improved night/adverse weather sensors and improved command and control capabilities that permit multiple air vehicle operations from a single ground control station as well as operations at greater ranges. In a parallel effort the development of other mission capabilities for mini-RPV's is being pursued to provide a broad range of capabilities for use beyond the FEBA. Commonality of components within the Army programs and with other service programs is being pursued. The major activities to date have been the Aquila System Technology Demonstrator Program, which completed testing in FY78, and its associated supporting technology programs.

G. (U) RELATED ACTIVITIES: Within the Army, Exploratory Development of RPV technology is conducted under Program Element (PE) 6.27.32.A, RPV Supporting Technology. Full-scale engineering development (FSED) of the first-generation RPV will be conducted under PE 6.47.30.A, Remotely Piloted Vehicles. This program element (6.37.25.A) provides an Advanced Development base for transitioning Supporting Technology programs into Engineering Development. Air Force RPV programs consisting of PE 6.37.39.F, Advanced RPV's, and PE 6.47.46.F, Expendable Drones, are being monitored to preclude duplication of effort and commonality of design where possible. Periodic meetings are being held between the Army and Air Force RPV program managers to further this initiative. Interoperability is being pursued through a Memorandum of Understanding with the United Kingdom (UK). At the current time, there is no duplication of effort in mini-RPV's within the Services.

H. (U) WORK PERFORMED BY: US Army Aviation Research and Development Command, St Louis, MO; Combat Surveillance & Target Acquisition Laboratory, US Army Electronics Research and Development Command, Fort Monmouth, NJ; Research and Technology Laboratories, Aero Mechanics Lab, Moffett Field, CA; Applied Technology Lab, Fort Eustis, VA; and the US Army Night Vision and Electro-Optics Laboratory, Fort Belvoir, VA. Contractors actively participating in the RPV development are Lockheed Missiles and Space Company, Inc., Sunnyvale, CA; Honeywell, Lexington, MA; Harris Corporation, Melbourne, FL; and Norden Systems, Norwalk, CT.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 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. In FY76, a demonstration was conducted using the Aeronutronics Ford (formerly Philco Ford) PRAIRIE II RPV to laser

Program Element: #6.37.25.A Title: Remotely Piloted Vehicle (RPV's)/Drones
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Tech Development

designate a tank target for a laser seeking Cannon Launched Guided Projectile (CLGP). A direct hit was scored. During this same time period, an initial effort was made to integrate a small, lightweight jammer in a mini-RPV. Based on general requirements derived from the Remotely Piloted Aerial Observer/Designator System (RPAODS) program, the Aquila System Technology Demonstration Program was established in FY75. Contractor flight testing of Aquila was initiated in mid-FY 1976. In April 1976, after a series of unsuccessful tests, the program was stopped and thoroughly reviewed by the contractor and an Army Review Team. Problems were traced to faulty procedures and designs and some instances of inadequate reliability and testing. Over 30 engineering changes resulted from the review and after extended ground testing, the program continued successfully. Aquila flew 218 flights and successfully demonstrated automatic launch, flight and navigation; semiautomatic recovery in an unimproved area; target detection, recognition and laser rangefinding/designation, artillery adjustment and handoff of control from one Ground Control Station to another. A second RPV laser designation for the COPPERHEAD precision guided munition was successfully performed in FY78. Formal user testing was conducted in simulated field conditions. User and developer testing was concluded in FY78. Information acquired from this program was used in the development of the system Required Operational Capability. The RPV was approved to enter Full Scale Engineering Development (FSED) by Headquarters Department of the Army (HQDA) in late FY78 and has been transitioned to Program Element (PE) 6.47.30.A, Remotely Piloted Vehicles. While the objectives of the Aquila program were met, many problem areas were identified that required parallel development effort. These programs focused on improvements in propulsion, launch and recovery techniques, servo-actuators, and manufacturing and design techniques. An anti-jam data link program was initiated in FY76 to provide an improved command and control capability. The resulting hardware consisted of two airborne data terminals integrated in Aquila RPV's and one ground station. Flight testing was successfully concluded in FY78. The resulting system provided the baseline for the data link that is to be used on the RPV under PE 6.47.30.A, RPV. Survivability/vulnerability studies, testing and simulations were conducted in FY78. These included live firing ballistic weapon tests as well as infrared (IR) and radar tracking tests and simulations. Work is continuing in this area. Additional efforts included night sensor Forward Looking Infra-Red (FLIR) tests on manned aircraft; flight testing of tunable and barrage jammers; parachute recovery tests and engine and propeller test and evaluation. Requests for Proposals (RFP's) were issued for two FLIR sensors of Mini-RPV size and weight.

2. (U) FY 1980 Program: Development of night sensors (FLIR) will be the major thrust. The basic initiative is to build two advanced development night sensors; one sensor employing serial scan technology, the other parallel scan technology. These sensors will also be effective in degraded visibility conditions during daylight hours. These sensors will include a FLIR imagery sensor, laser rangefinder/designator, autotracker and associated electronics. Physical design of the sensor package will meet requirements for a mini-RPV payload. The United Kingdom (UK) vertical take-off and landing RPV program will be monitored under the purview of the US/UK Memorandum of Understanding (MOU) on RPV interoperability.

Program Element: #6.37.25.A Title: Remotely Piloted Vehicle (RPV's)/Drones
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Tech Development

3. (U) FY 1981 Planned Program: The development of two advanced development night sensors, FLIR, initiated in FY80 will be completed. A comprehensive testing program for the two FLIR's will begin. This testing program will consist of extensive bench testing as well as integration into manned aircraft for flight testing. The flight testing will evaluate the effectiveness of the FLIR to perform its mission in a variety of atmospheric conditions. The atmospheric conditions to be evaluated will include dust, smoke and battlefield obscurants. The capability to adjust artillery fire will also be assessed. The sensors will also be evaluated under daylight conditions. An effort will be initiated to issue a Request for Proposal (RFP) for a Full Scale Engineering Development (FSED) program. This program would then transition to PE 6.47.30A, Remotely Piloted Vehicle, in FY82. A contract will be initiated to define the interface of multiple control and extended range capability to the data link and the RPV programs. Design effort will begin to incorporate the eye safe laser technology from the 6.2 program into a hardware configuration compatible with the RPV mission payload module.

4. (U) FY 1982 Planned Program: The multiple control and eye-safe laser development programs continue from FY81. Initiatives with the UK on RPV interoperability continue. Development of a survivability simulation capability to supplement the FSED survivability program will be initiated. This modeling will be designed to assess survivability aspects of RPV's outside the scope of the FSED program.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.31.A
Title: Manpower and Personnel
DoD Mission Area: #552 - Environmental and Life Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1936	3121	3230	3738	Continuing	Not Applicable
A792	Manpower and Personnel	1936	3121	3230	3738	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: One of the Army's most critical missions is to man the force. To accomplish this, adequate numbers of capable individuals must be attracted into the officer and enlisted ranks and their abilities used appropriately. Proper manning of the force is critically affected since the number of available military-age youth is declining while complex new military systems and equipment require increasing numbers of talented soldiers. As a result, there is a critical need to improve recruiting, utilization of current soldiers by more effective personnel management at the unit level, and retention of soldiers, and to determine what the impact of new system development will be upon the available manpower pool. Manpower and personnel research has the following objectives: Identify ways to broaden the population base for Army recruiting and improve recruiting practices. Determine factors which appeal to new enlistees and soldiers. Improve methods for assessing and rewarding soldier performance. Reduce attrition of trained personnel. Enhance non-material reward for Army service. Ensure that the manpower and personnel available can be used effectively in the organizational structure and materiel and weapons systems envisioned for the future Army. Develop cost-effective ways of determining the personnel impact of new system development, to relate the personnel requirements of new systems to the available supply of trained or available manpower.

C. (U) BASIS FOR FY 1981 REQUEST: This research is required to improve recruiting assessment center techniques for selecting effective recruiters; assure that adequate manpower and personnel planning is included very early in design of new weapons and materiel systems; determine factors for enhancing cohesion of military units; develop personnel management methods to reduce attrition of first-tour soldiers; evaluate tools and techniques to increase the effectiveness of organizations; develop techniques for managing turbulence, rotation and cross-training of crews to maintain unit effectiveness; determine impact of selected personnel management variables on individual readiness.

Program Element: #6.37.31.A Title: Manpower and Personnel
DoD Mission Area: #552 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE					
Funds (Current Requirments)	1936	3121	3230	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	1823	3121	3868	Continuing	Not Applicable

Changes in this program element in FY 1979 are primarily a result of restructuring to meet an urgent need to improve Army manpower levels. Changes in FY 1981 resulted from OSD actions to eliminate planned increases for inflation and salary costs.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.37.31.A
Title: Manpower and Personnel
DoD Mission Area: #552 - Environmental and Life Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Research has been initiated to identify successful recruiters through use of assessment center techniques. Previous efforts identified factors related to attrition and potential performance failure of soldiers. Research to determine what motivates young people to join the Army and Reserves and what causes their subsequent high attrition continues. Research on retention and reenlistment for both Active and Reserve Component forces will relate characteristics of successful reenlistees to Army reenlistment policies. Other research concentrates on methods to improve officer precommissioning selection as well as training, and on unit personnel management techniques to increase unit effectiveness. Work continues on methods to evaluate crew requirements of new weapons systems during operational tests and to relate the requirements to aptitude distributions of the population. Work on effectiveness of organizations will explore non-survey methods for systematic diagnosis of organizational problem areas and on identifying techniques for dealing with them. A new program is being initiated to determine the impact of new system acquisitions upon the affordability of personnel, both in terms of the potential manpower pool and impact on current Army force structure.

G. (U) RELATED ACTIVITIES: Through the Department of Defense, this work is coordinated with Naval Personnel Support Technology, P.E. 6.27.63.N; Navy Manpower Control System Development, 6.37.07.N; Air Force Personnel Utilization Technology, 6.27.03.F. Related Army Program Element is Manpower, Personnel and Training, 6.27.22.A. Interservice coordination is effected through tri-service Technical Advisory Groups (TAG) in such areas as education and training, manpower, personnel, and organizational effectiveness. The purpose of the TAG is to coordinate Service developments and eliminate undesirable overlap and duplication of effort.

H. (U) WORK PERFORMED BY: Contractors include: Systems Development Corp., Santa Monica, CA; Personnel Decision Research Institute, Minneapolis, MN; Galler Associates, Arlington, VA; McBer and Co., Boston, MA; Human Sciences Research, Inc., McLean, VA. More than three-fourths of the funds expended for contracts are for competitive procurements. In-house research is performed by the US Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA, and its field units at Presidio of Monterey, CA; Ft Benning, GA; Ft Bliss, TX; Ft Hood, TX; Ft Knox, KY; Ft Leavenworth, KS; Ft Rucker, AL; Ft Sill, OK; Ft Benjamin Harrision, IN; and Germany.

Program Element: #6.37.31.A Title: Manpower and Personnel
DoD Mission Area: #552 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Past efforts have produced: Military Applicant Profile (MAP) test to screen out poor candidates for enlistment, resulting in a 24 percent projected increase in retention of lower mental category personnel accepted for enlistment; Army input to Armed Services Vocational Aptitude Battery (ASVAB) tests for the Joint US Army Recruting Command/US Army Recruiting Program; identification of initial factors affecting motivation to enlist in the Reserves and soldier reenlistment in the Army; guidelines for managing tank crew turbulence to maintain high levels of tank gunnery performance which have improved tank crew performance; Reserve Officer Training Corps (ROTC) scholarships selection system, including improvements and a management and leadership training package for ROTC; revised ROTC Cadet Evaluation and Officer Selection batteries which result in high correlations between predictions of officer performance and actual data; impact of varying percentages of women on performance of combat support units which showed that up to 35 percent women can be used in these units; identification of factors affecting soldier attrition during service in Europe; data for the President's Commission on Military Compensation, on Viet Nam deserters, and for the Army discharge review program which were used to help administer that program; paper-and-pencil test screening battery for assigning armor crewmen so that unit commanders can better use their soldiers, as well as experimental job sample techniques for selecting tank gunners; revised Flight Aptitude Selection Test (FAST) to improve the selection ratio of Army aviators; data on Reserve enlistment/reenlistment motivations for reserve unit use; evaluation of the Army's current organizational effectiveness (OE) program which has been used to increase the program's efficiency.

2. (U) FY 1980 Program: Produce an improved program for determining the personnel aspects of new system acquisition. A user manual for officer/cadet selection and evaluation batteries. Develop vocational interest scales for Army jobs for incorporation into the Armed Services Vocational Aptitude Battery (ASVAB) to improve the ASVAB for Army applications. Develop an assessment center to improve recruiter selection, and to determine successful recruiting practices. Develop an improved method to assign aviator trainees to advanced undergraduate training in the initial entry rotary wing (IERW) program so as to reduce attrition costs. Determine minimum personnel and training requirements for the Army acquisition process (support of ASARC) for FY 1980 and relate these to the adequacy of manpower and personnel planning and projections associated with acquisition of emerging weapons and support systems. Design a computer simulation model for assessing alternative reenlistment policies. Develop methods for remediating unprogrammed losses in the reserves. Determine critical competencies for organizational effectiveness staff officer (OESO) and evaluate the non-commissioned officer organizational effectiveness program. Initiate research on the impact of quality-of-life factors on individual and unit readiness and evaluate the impact of alienation among soldiers. Initiate the evaluation of the Army personnel management system at Division and lower unit levels.

Program Element: #6.37.31.A Title: Manpower and Personnel
DOD Mission Area: #552 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

3. (U) FY 1981 Planned Program: Improve personnel requirements estimation process for new Army systems and develop guidelines and models for determining need for new manpower as well as current personnel availability for new system acquisition. Identify characteristics and motivation of successful officers and enlisted men. Evaluate management motivation techniques as applied in the Army. Determine methods for recruiter selection, training and rewards. Determine improved measures for evaluating soldier performance. Develop criteria for identifying training and education needs of leaders early in their career. Develop procedures for improving retention and reenlistment of quality soldiers. Determine organizational diagnostic procedures and effective approaches for organizational leadership training for senior commanders as they relate to improving organizational functioning. An approach to measures of quality-of-life related to personnel readiness and personnel retention factors will be tried out. Results on performance of mixed-sex reaction teams assigned tactical contingency missions will be experimentally determined. The effect of level of solder stamina and strength on unit combat performance and unit esprit will be tested. Development of improved personnel management techniques for unit commanders will continue.

4. (U) FY 1982 Planned Program: Research will produce: Prediction models for personnel requirements and assignment for system acquisition; methods for a recruiter reward system; new selection and classification tests; data to determine armor crewmen aptitude requirements; improved training and readiness in armor units; TACFIRE training programs appropriate for reserve components; officer career development programs; computer simulation procedures for reenlistment policy planners; effective OE techniques, methods and programs; organizational leadership training for senior commmanders; relationship of personnel readiness to quality-of-life issues; relationship between crew/team effectiveness and cohesion in various operational settings; methods for aggregating personnel requirements and estimating life cycle costs for future Army weapons and materiel systems.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.32.A
Title: Combat Medical Materiel
DoD Mission Area: #552 - Environmental & Life Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	106	111	141	182	Continuing	Not Applicable
A836	Combat Medical Materiel	106	111	141	182	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The modern battlefield demands a medical system matched in mobility to the combat forces it supports and capable of effectively handling a large number and variety of combat injuries. This advanced development program is required to field new and improved medical equipment essential to the concept of a mobile, medically-responsive field health care system.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Funds are necessary to advance and field highest priority items required by the field medical system. Those requested represent the absolute minimum that will maintain the development cycle to fielding of essential medical materiel.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE					
Funds (current requirement)	106	111	141	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	106	111	145	Continuing	Not Applicable

Slight decrease in FY 1981 funds results from minor program revisions.

E. (U) OTHER APPROPRIATION FUNDS: ($ in thousands). Not Applicable.

Program Element: #6.37.32.A
DoD Mission Area: #552 - Environmental & Life Sciences (ATD)

Title: Combat Medical Materiel
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The need for tactical flexibility in modern warfare and new weapon developments has increased the problems and complexity of diagnosing and treating large numbers of devastating combat injuries. This program is an aggressive research effort to develop new and improved medical field equipment in areas such as diagnostic and special purpose equipment; treatment and evacuation; insect control and eradication; dental and medical support in chemical defense. Special emphasis is placed on simplicity for use by non-professionals, mobility to minimize burdens on the combat logistical system and utility under a variety of environmental conditions.

G. (U) RELATED ACTIVITIES: The program contains items and systems that have progressed to advanced development from related exploratory development Program Element 6.27.72.A, Combat Casualty Treatment Technology. Related engineering development Program Element is 6.47.17.A, General Combat Support, Project D832, Combat Medical Materiel. Army development is closely coordinated with Air Force and Navy medical materiel development programs via formal symposiums and informal contact to insure that there is no duplication.

H. (U) WORK PERFORMED BY: In-house work is performed by the US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Conducted field test for controlled-release pesticide formulations in support of requirements for insect control systems. Completed development plan in response to newly identified requirement for a complete field clinical laboratory which will incorporate the latest in blood-screening devices and whole body examining equipment for diagnostic purposes.

2. (U) FY 1980 Program: Initiate technical feasibility studies for new components identified for incorporation into the field clinical laboratory. Present one or more controlled-release pesticide formulations for operational test.

3. (U) FY 1981 Planned Program: Continue technical feasibility test to refine the essential characteristics of the field clinical laboratory system. Continue (year 4 of 5) developmental and operational tests to determine efficacy of controlled-release pesticide formulations. Personnel to be utilized: 3 professional and 3 support.

4. (U) FY 1982 Planned Program: Initiate development of prototypes of modular components for the field clinical laboratory system. Target completion date for the field laboratory system is 1983. Initiate advanced development of the patient decontamination system estimated for completion in 1983. Complete efficacy tests of controlled-release pesticide formulations.

Program Element: #6.37.32.A
Title: Combat Medical Materiel
DoD Mission Area: #552 - Environmental & Life Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

5. (U) Program to Completion: This is a continuing program to provide advanced development of select high priority items moved from exploratory development efforts.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.34.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Combat Engineering Systems
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	0	232	261	Continuing	Not Applicable
DT08	Military Construction and Engineering	0	0	232	261	Continuing	Not Applicable

B. (U) BRIEF DISCRIPTION OF ELEMENT AND MISSION NEED: This program provides for the validation, in a prototype environment, of concepts and techniques developed in exploratory development programs to provide weapon effects and combat engineering support on the battlefield. One of the mission area shortfalls is the impact of debris clouds created by exploding ordinance on electro-optical sensor systems used for target acquisition and weapon system guidance. Work in this program will address the characterization and measurement of the debris cloud environment.

C. (U) BASIS FOR FY 1981 RDTE REQUESTS: The affects of obscuration, caused by battlefield operations, on electro-optical sensors in weapons systems must be known and understood to maximize the efficiency of the weapons systems. Analytical methods for identification and quanitification of debris clouds will be developed and compared with the characteristics of the electro-optical sensors to provide methods or changes in operational characteristics to avoid or reduce, the degredation effects of the obscurants.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES ($ in thousands): Not Applicable

E. (U) OTHER APPROPRIATIONS FUNDS: Not Applicable

Program Element: #6.37.34.A Title: Combat Engineering Systems
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The visability of the mid and high intensity battlefields will be obscured by smoke, debris, fog, snow and dust propelled into the air by nature, combat operations and explosives to the extent that the electro-optical sensors of modern weapons will be affected. This program element is to apply the technological solutions developed in exploratory development to the electro-optical sensors of weapons systems to minimize the degradation of the sensors and allow the weapons system to function efficiently on the dirty battlefield. The aim of the program element is to rapidly transfer to the field those systems, products and techniques that will improve the survivability and operational capability of both men and material in a mid to high intensity conflict.

G. (U) RELATED ACTIVITIES: This program element will apply the exploratory development performed under Program Element 6.27.19.A, Project AT40, Mobility and Weapons Effects Technology. This work is coordinated with the activities of the other services in the Tri-Service Plan for Atmospheric Transmission R&D. The lead laboratory for the Army Program is the Atmospheric Sciences Laboratory. The Naval Research Laboratory is lead laboratory for the Navy and the Air Force lead laboratory is the Air Force Geophysics Laboratory.

H. (U) WORK PERFORMED BY: The US Army Waterways Experiment Station, Vicksburg, MS, is to perform 75% of the work in-house. The balance is split evenly between the Atmospheric Science Laboratory, White Sands Missile Range, NM, and Teledyne-Brown, Huntsville, AL.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 Prior Accomplishment: This program element was not funded in FY 1979 and FY 1980.

2. (U) FY 1980 Program: This program element was not funded in FY 1980.

3. (U) FY 1981 Planned Program: Analytical methods for identification and quantification of clouds of debris which are thrown into the air during combat operations will be developed. The electro-optical sensor equipment supporting combat operation on the realistic battlefield will be evaluated and optimized. The methods used to define battlefield obscuration will be Program demonstrated and field tested in this program. The impact of the dirty battlefield on the electro-optical sensor systems in weapons systems will be quantified and validated.

4. (U) FY 1982 Planned Program: Follow on development of the work completed in the FY 1981 program will continue. The effectiveness and cost comparison of hardening and passive counter surveillance procedures for protection of fixed installation facilities will be demonstrated. The cost in dollars and time to implement each procedure will be evaluated with troop exercises and simulated combat sorties to determine the most economical and effective mix of techniques to employ.

Program Element: #6.37.34.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Construction and Engineering
Budget Activity: #2 - Advanced Technology Development

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.39.A
Title: Human Factors in Training and Operational Effectiveness
DoD Mission Area: #522 - Environmental and Life Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3043	1909	2547	3268	Continuing	Not Applicable
A793	Human Factors in Training and Operational Effectiveness	3043	1909	2547	3268	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army has over 40 major new systems programmed for acquisition in the next 5 to 10 years. Detailed development of methodologies for effective human performance in those new systems is required as each new system nears operational use. The soldier must be considered as a part of the system. Techniques to test the real world effectiveness of systems must be validated and tailored to the specific operational use for which they are intended. Shortcomings in the man-machine match will require the additional development of human performance aids so that the system can achieve full performance capability. This program will develop those human factors capabilities associated with the operational employment of Army weapons systems. This includes a human factors evaluation of the system during developmental and operational tests at maneuver areas, training areas, firing ranges in the continental United States (CONUS) and overseas, as well as evaluation and diagnosis to overcome human factors shortcomings in Army equipment/system maintenance and repair.

C. (U) BASIS FOR FY 1981 REQUEST: Human factors evaluations must occur during operational tests of new systems to assure that both soldier and system requirements have been met. Results of the evaluations then will be analyzed to compare human factors in actual performance with skill and training predictions. Operational data will be obtained from major armor, infantry, artillery and air defense systems including the infantry fighting vehicle/cavalry fighting vehicle (IFV/CFV), general support rocket system (GSRS), stand-off target acquisition system (SOTAS), PATRIOT missile system and command and control systems. Results will be used by TRADOC system managers and DARCOM project managers to establish operating and maintenance procedures, define duties of individual crew members, and assess workload as a basis for determining numbers and skill levels of personnel needed for specific new weapon systems. Guidelines are furnished for human factors evaluation of weapons and equipment during operational testing. Demonstrated improvements in field operating procedures and techniques are incorporated into training and doctrinal material, e.g., night time surveillance patterns and nap-of-the-earth navigation.

Program Element: #6.37.39.A Title: Human Factors in Training and Operational Effectiveness
DoD Mission Area: #522 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands):

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE					
Funds (Current Requirements)	3043	1909	2547	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	1691	2309	3195	Continuing	Not Applicable

This was a new program element created in FY 1980. FY 1979 funding represents restructuring from other programs in response to DoD and Congressional guidance. The change in FY 1981 represents a reduction due to DOD elimination of planned increases. The decrease in FY 1980 reflects a reduction by Congress.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.37.39.A
DoD Mission Area: #552 - Environmental and Life Sciences (ATD)
Title: Human Factors in Training & Operational Effectiveness
Budget Activity: Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The fielding of new weapon systems imposes a critical need to evaluate these systems to determine if soldier abilities and acquired skills are sufficient for effective tactical employment of the systems. This program covers research to match system demands with manpower and personnel capabilities. Major efforts focus on armor, air defense, artillery, infantry and automated or semi-automated tactical information systems; improved procedures for operating and maintaining rotary wing aircraft; human factors operational test and evaluation for major weapons systems to identify improvements needed in operating procedures, doctrine, and manning levels; and the development of technology to predict training requirements early in the development of new systems.

G. (U) RELATED ACTIVITIES: Coordination and dissemination/transfer of research is through participation in the Tactical Operations System Test Integration Working Group and the Panel for Helicopter Human Resources Research, through annual DoD budget and apportionment reviews, and through membership in tri-service committees such as the Human Factors Technical Advisory Group, the Human Factors Test and Evaluation Subgroup, and the DoD/NASA Simulation Working Group. Additional coordination is obtained through participation in the NATO Working Group on Fidelity Requirements of Flight Simulation and the Technical Cooperation Program Panel on Human Factors in Command and Control Systems. Active participation in these coordination groups has the objective of reducing and eliminating overlap and duplication of effort.

H. (U) WORK PERFORMED BY: Contractors include: Kinton Corporation, Alexandria, VA; Manned Systems Sciences, Los Angeles, CA; Human Resources Research Organization, Killeen, TX; System Development Corporation, Leavenworth, KS; Vector Research, Ann Arbor, MI; Canyon Research, Inc., Ft Rucker, AL. In-house work is performed by the US Army Research Institute for the Behavioral and Social Sciences and its field units distributed at major installations, including Ft Benning, GA; Ft Bliss, TX; Ft Hood, TX; Ft Knox, KY; Ft Leavenworth, KS; Ft Ord, CA; Ft Rucker, AL; Ft Sill, OK; Ft Benjamin Harrison, IN; and Germany.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: (a) Identified changes in division command and control procedures, and in personnel and skill requirements necessary to deploy the Tactical Operations System; (b) developed integrated operator support for remotely monitored sensors; skill performance aids, training packages and deployment doctrine resulted in a performance increase of up to

Program Element: #6.37.39.A Title: Human Factors in Training and Operational Effectiveness
DoD Mission Area: #522 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

80%; (c) develop ed and implemented a training program in battle planning and execution for battalion command groups using the combined arms tactical training simulator (CATTS); (d) developed procedures for maintaining helicopter pilot proficiency in operational units; (e) conducted operational test and evaluation of training and personnel requirements for tank systems; (f) developed procedure. for analyzing enemy movements with the airborne stand-off target acquisition system (SOTAS); (g) completed research identifying operational requirements for nap-of-the-earth flight.

2. (U) FY 1980 Program: Develop procedures for operating and maintaining armor, artillery, air defense and automated communications systems. Conduct research on the operational concept and maintenance workload associated with the BLACKHAWK aviation system. Conduct research on reduction of pilot workload for the Advanced Attack Helicopter. Conduct human factors operational test and evaluation on the XM-1 Tank, Tactical Operations System, and Restructured Heavy Division. In coordination with the US Army Test and Evaluation Agency (OTEA), development of a handbook for implementing human factors during operational test and evaluation will be completed.

3. (U) FY 1981 Planned Program: Develop operating procedures for tactical management of intelligence collection systems. Conduct research on operation and maintenance of combat aviation systems. Conduct human factors analysis during operational test and evaluations on battlefield target acquisition systems, the Combat Electronic Warfare and Intelligence Group, and the Corps Tactical Operations Systems. Conduct field evaluations of handbook on human factors criteria for use during operational test and evaluation. Develop user requirements for battlefield automated systems. Determine effectiveness of new combat aviator training programs assigned to units. Evaluate aviator performance in Advanced Attack Helicopter training.

4. (U) FY 1982 Planned Program: Develop operator procedures for using tactical operational computers in intelligence management, field artillery, fire control and air defense command and control. Conduct human factors test and evaluation of infantry fighting vehicles and cavalry fighting vehicles. Develop human factors procedures for field exercises at the National Training Center. Assess human performance measurement techniques for operational combat information and intelligence systems. Validate human performance factors in combat simulations. Determine aviator performance requirements for tactical proficiency operations.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.42.A
Title: Advanced Electron Devices
DOD Mission Area: #551 - Electronics & Physical Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1345	1999	2875	4971	Continuing	Not Applicable
DF32	Advanced Electron Devices	1345	1999	2875	4971	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This advanced development program in electron devices, component assemblies and subsystems will provide new "technology insertion" into a substantial number of systems currently scheduled for or already under development or in initial production. 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. This program will permit substantial performance or cost improvement to take advantage of major technology advances that have occurred in parallel with ongoing systems developments so that technologically obsolete systems will not be fielded. Emphasis will be placed on insuring performance capability, while stressing reliability, cost effectiveness, and modular packaging. The approaches pursued include selection of optimum component technology and solution of module interface problems based on defined user needs. Generally more than one system is impacted so that development costs for these items cannot be borne by a single system.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: A significant portion of the next land war will be fought under conditions of severely limited visibility. The Army will need a low-cost capability to detect and recognize battlefield targets through smoke, adverse weather, and camouflage. Millimeter wave device development is being promoted because of its ability to penetrate smoke and fog, and new concepts for decreasing costs of devices are being pursued. The development and fabrication of low-cost Indium Phosphide (InP) Gunn devices for subharmonic receivers at 60 Gigahertz (GHz), low-noise mixers at 140 GHz, and high-power coherent Impact Avalanche Transit Time (IMPATT) sources at 94 GHz will be continued and devices obtained will be evaluated in tank-mounted radars (Surveillance and Target Acquisition Radar for Tank Location and Engagement (STARTLE)) and terminal homing beam rider systems. The development of a lightweight, 1.0 kilowatt (kw) peak, 10-watt average power, 3.2-millimeter wave tube for use in Remotely Piloted Vehicle (RPV) target acquisition and air defense fire control radars will

Program Element: #6.37.42.A
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be continued. At the present time, US forces have a limited capability to determine range to targets and terrain features; however, these existing devices are too heavy and large. To resolve this problem, the program providing for a compact nanosecond pulser for Carbon Dioxide (CO_2) laser target designators/rangefinders for close combat systems will be continued. The volume of the power supply and pulser will be reduced, allowing for the placement of the entire laser in the available space on the XM1 tank. The tempo of modern battle demands timely information from all sources, rapidly processed and made available to the commander. Development will continue on low-cost, small, low-power charge coupled devices for radar signal processors and electronic warfare (EW) target classifiers and low-cost Large-Scale Integration/Very LSI (LSI/VLSI) EW signal processing modules. The development of a sunlight-legible, high-contrast, multicolor display for the AN/APR-39 radar warning receiver will be completed. The advanced development of an L-band surface acoustic wave oscillator for the Field Artillery Meteorological Acquisition System (FAMAS) radiosonde will be continued. The program providing for low-cost, high-stability resonators for frequency standards for advanced Electronic Counter Countermeasure (ECCM) for antijam communication, navigation, and Identification Friend or Foe (IFF) systems will be started. The program to develop a second source improved transmitter tube to assure an adequate supply and competitiveness of high-cost tubes for the AN/TPQ-36, Mortar Locating Radar, will be continued. A lower cost, more reliable K-Band solid-state 10-watt power amplifier module will be developed for the Modular Integrated Communications Navigation System (MICNS) data link.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1345	1999	2875	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	700	1999	3499	Continuing	Not applicable

Funding differences between Congressional Descriptive Summaries submitted last year (1980) and this year are as follows:

1. (U) FY 1979 - There was an actual expenditure of $1,345 (+$645K) over the estimated amount ($700K); this increase was effected by a reprogramming action by the US Army Materiel Development and Readiness Command (DARCOM) to fund high priority electronic devices critical to the development of Army Systems.

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2. (U) FY 1980 - No change

3. (U) FY 1981 - The $624K decrease for FY81 is due to reprogramming for higher priority Army requirements.

E. OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.37.42.A
DOD Mission Area: #551 - Electronics & Physical Sciences (ATD)

Title: Advanced Electron Devices
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective is to provide advanced development models of electronic components, assemblies, and subsystems for application and technology insertion in military systems. Proven device feasibility will be directed to specific system applications. The approach will include the development of sufficient numbers of models/modules to determine reliability, performance, reproducibility with major emphasis on greater commonality of application and lower life cycle costs. This program is critical to the improvement in fielded Electronic Warfare (EW), Radar and Communications Systems.

G. (U) RELATED ACTIVITIES: Coordination is achieved with other Government agencies through participation in the activities of the Department of Defense Advisory Group on Electron Devices (AGED) to preclude any duplication of effort. Related PE 6.27.05.A, Electronics and Electron Devices.

H. (U) WORK PERFORMED BY: The Electronics Technology and Devices Laboratory, Fort Monmouth, New Jersey. This laboratory is scheduled to use approximately 20% of the program funds in-house. The principal contractors are: Sanders Associates, Merrimack, NH; Varian Associates, Palo Alto, CA; Hughes Aircraft, Fullerton and Torrance, CA; Watkins-Johnson, Palo Alto, CA; Bendix Corp., Towson, MD; Texas Instruments, Dallas, TX; Norden Systems, Norwalk, CT; and Radio Corporation of America (RCA), Camden, NJ.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: The ruggedization and improvement program of the high-power final output traveling wave tube (TWT) for the Artillery Locating Radar, AN/TPQ-37, is being continued. The improved TWT's have been installed in the transmitter testbed and are being evaluated for the 5,000 hours' operating life objective. The high temperature graphite infrared (IR) source contractual program to develop a higher power output and increased long wavelength source for the protection of Army aircraft against IR heat seeking missiles is nearing completion, and deliverable items will be evaluated internally. The total package design for the low-cost, mini-TWT I-band expendable jammer was completed and evaluation of the package for noise quality, tunability, and operational effectiveness begun. Efforts have been started to fabricate prototype 94 GHz sources and 60 GHz InP Gunn diodes for subharmonic receivers to be used in the millimeter wave antitank radar, terminal homing for projectiles, missiles, and secure communications. Work will continue on the multiyear program to develop Large-Scale Integrated/Very LSI (LSI/VLSI) low-cost EW signal processing modules for direct technology insertion in equipment upgrades. The contractual program for the development of an operating discrete Fourier Transform for realtime signal processors for radar, remote sensors, and secure communications has started. The contractual program for the development of a high-contrast Cathode Ray Tube (CRT) display module, providing a sunlight-legible multicolor display for the radar warning

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receiver, AN/APR-39, has started. A new packaging concept has been proposed by the contrator in the development of the tactical miniature crystal oscillator to be used as a reference in time-ordered communications, navigation, and position location systems.

2. (U) FY 1980 Program: The integration and evaluation of the high-power final input TWT's for the Artillery Locating Radar, AN/TPQ-37, from the prime and second-source vendors will be completed, and a data base on arc rate, microprocessor control, and system optimization will be established for the product improvement program. A similar tube improvement and second-source tube capability will be started for the Mortar Locating Radar, AN/TPQ-36, to assure an adequate supply and competitiveness of high-cost final output power tubes which are of different frequency than the AN/TPQ-37 tubes. The development of the mini-Traveling Wave Tube (TWT) I-Band expendable jammer package will be completed, and prototype models furnished to the Electronic Warfare (EW) Laboratory for evaluation. The program to develop and fabricate prototype low-noise Indium Phosphide (InP) Gunn oscillators for 60 GHz subharmonic receivers for antitank application will be continued. Ten receiver modules will be developed, demonstrating reproducibility, uniformity, mechanical, and electrical reliability. The program to develop and fabricate prototype sources capable of 10 watts of puls power at 94 GHz for mini-Remotely Piloted Vehicle (RPV) target acquisition radars will be continued. The advanced development of a 3.2 millimeter wave tube, capable of 1.0 kw peak and 10 watts average power, for use in an RPV-borne target acquisition and air defense fire control radar, will be started. The development of pulser modules for a 10.6 micron laser rangefinder and designator capable of penetrating smoke, fog, and inclement weather for antitank warfare and missile guidance will be initiated. The volume of the laser presently under development will be reduced, enabling it to be placed in the space available on the XM1 tank. The multiyear program to develop high-speed, low-power LSI signal processing modules for direct technology insertion into the Electronics Intelligence (ELINT) processor QUICKLOOK-II and Teampack upgrades will be continued. The development of sunlight-legible, multicolor display modules capable of night-adaptive use with the AN/APR-39, Radar Warning Receiver, will be continued. The Advanced Development (AD) of a tactical miniature crystal oscillator to be used in Joint Tactical Information Distribution System (JTIDS)-type systems will be completed. The development of a Surface Acoustic Wave (SAW) frequency synthesizer emphasizing low cost, lower power consumption, and minimum size with improved stability, providing meteorological/navigational radiosonde data for FAMAS, will be started. The development of a practical discrete Fourier Transform modular subsystem for pulsed doppler radars and target classification for EW processors will be continued.

3. (U) FY 1981 Planned Program: A growing realization by the United States Army indicates the necessity to fight a significant portion of the next land war under conditions of severely limited visibility. The Army will need a low-cost capability to detect and recognize battlefield targets through smoke, adverse weather, and camouflage. Millimeter wave device development is being accelerated because of its ability to penetrate smoke, fog, and new concepts for lowering the costs for

Program Element: #6.37.42.A
DOD Mission Area: #551 - Electronics & Physical Sciences (ATD)

Title: Advanced Electron Devices
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components are being pursued. The potential for cost reduction will also be accelerated by producing some systems in large quantity in either a future version of the STARTLE antitank radar or terminal seekers for tactical missiles or smart munitions. The development and fabrication of low-cost InP Gunn devices for subharmonic receivers at 60 GHz and high-power sources at 94 GHz will be completed, and effort on low-noise mixers at 140 GHz started. Devices obtained will be evaluated in tank-mounted radars (STARTLE), terminal homing missiles, and smart munitions. At the present time, US forces have a limited capability to determine range to targets and terrain features; however, these current devices are too heavy and large. To resolve this problem, the program providing for a compact nanosecond pulser for the 10.6 micron laser target designator/rangefinder will be continued, the volume of the power supply and pulser reduced, allowing for the placement of the entire laser in the available space of the XM1 tank. The Army has a tactical need for the capability to acquire and engage targets beyond ground line-of-sight with an accuracy and timeliness corresponding to its ability to strike these targets and to provide intelligence of enemy activities and to relay this information back with as much antijam protection as possible. The development of a lightweight, 1.0-kw peak, 10-watt average power, 3.2 millimeter wave tube for use in RPV target acquisition radars will support this requirement. A program will be initiated to develop a low-cost, more reliable, 10-watt, Ku-band, anitjam data link power amplifier. Continuous surveillance, identification, location, and classification of enemy second-echelon forces, and critical node analyses are tactics which may allow the US Army to fight, survive, and win in an environment in which it is outnumbered and outgunned. In support of this need, the development of low-cost, small, low-power, analog charge coupled devices (CCD's) used for realtime radar signal processing and target classification will be completed. The development of specific LSI/VLSI circuit modules for EW signal processing will continue. The development of an affordable full I/J-band jammer power amplifier to protect Army aircraft against enemy air defense radars will be started. The development of low-cost, high-stability, quartz resonators for use in secure antijam communications, navigation, and identification systems (JTIDS) will be started. The AN/TPQ-36 high power final output Traveling Wave Tube (TWT) tube improvement and second-source development will continue. Five (5) professional and two (2) support personnel are involved in this project.

4. (U) FY 1982 Planned Program: The advanced development of prototype high-power coherent IMPATT sources at 140 GHz, capable of withstanding the shock and environment encountered in combat vehicles and missiles, will be started. The mixer diode program at 140 GHz will be continued by characterizing and evaluating diodes to obtain minimum burnout and maximum resistance to shock and vibration. The development of a compact nanosecond pulser for the 10.6-micron laser target designator/rangefinder for the XM1 tank will be completed. A two-year program will be started on the development of a 4-nanosecond pulser for the 3.2-millimeter wave transmitter for the Remotely Piloted Vehicle (RPV) radar and air defense fire control radar. The development of a 1.0-kw peak, 10-watt average power, 3.2 millimeter wave tube will be completed. The improved high-power output tube for the AN/TPQ-36 radar will be completely integrated into the AN/TPQ-36 transmitter along with the evaluation of the microprocessor control and validation of arc protection and improved fault location. The present cost for decoys for

Program Element: #6.37.42.A Title: Advanced Electron Devices
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complex radars such as the AN/TPQ-36, 37, and PATRIOT approach the cost of the transmitter it is protecting. Recent exploratory results on TWT's give promise of developing decoy TWT amplifiers costing $5,000. Three tubes will be constructed in the AN/TPQ-37 band. A breakthrough in extremely high power at K-band reported in international literature has been obtained with the gyrotron tube for application of fusion research. The gyrotron has an excellent future as high-power millimeter wave amplifiers and oscillators, and undoubtedly will soon be applied in radar. Effort will be continued on the development of a low-cost, reliable, 10-watt, Ku-band amplifier for the RPV or Standoff Target Acquisition System (SOTAS) data link. Effort will be continued on the development of an affordable full I/J-band jammer power amplifier to protect Army aircraft against air defense radars. In FY82, the Phase I module development of the LSI/VLSI low-cost EW signal processing modules will be completed. A development will be started to build a graphic display/processor for the All-Source Analysis Center (ASAC), enabling the tactical commander to receive map format intelligence in near realtime. Sunlight-legible, cockpit interactive display panels displaying tactical emitter threat data in realtime will be developed for QUICKLOOK II, thereby eliminating the unacceptable delay presently inherent in the system wherein the information is transmitted to the ground and not made available to the technical observer in the aircraft.

5. (U) Program to Completion: This is a continuing program.

FY 1981 CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.43.A
DoD Mission Area: #552 - Environmental and Life Sciences (ATD)

Title: Education and Train
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7826	7105	8388	9079	Continuing	Not Applicable
A794	Education and Training	7826	7105	8388	9079	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Recent changes in military doctrine, the continuing introduction of a large number of sophisticated systems into the Army, and the resulting change in many required soldier skills and abilities are increasing the difficulties faced by unit commanders to manage and provide training programs, and to assess the effect of training on unit combat readiness. The objective of this program is to develop training techniques which will enhance and sustain the competence, motivation and performance of individuals and units; improve training methods, procedures and materials which support Army commanders in achieving their training objectives; enhance combat arms and combined arms unit training including armor, artillery, air defense and aviation crew training; develop methods for increasing skill retention and effective on-the-job training in units. This work supports Army-wide requirements for development of training techniques which realistically address combat tasks to be performed by Army units. The research results are used by the Army Training and Doctrine Command (TRADOC) in constructing advanced training in combat and technical skills for use in schools and operational units. Results also are applied to refresher training programs and to assist the unit commander in determining training needs and training loads.

C. (U) BASIS FOR FY 1981 REQUEST: Systematically specify the relationships between individual skills and team performance and develop methods for improving crew/team training, especially in combat arms. Develop training modules for remedial skills training; develop a test bed for combat unit training procedures to be evaluated for incorporation in the National Training Center; develop an individual self-paced and self-taught non-commissioned officer training system; conduct skills analysis and develop training techniques for XM-1 tank gunners, for artillery crews, and for air defense operators. Continue development and validation of techniques for effectively exporting training from Army service schools to unit training in the field. Continue to develope and evaluate skill retention predictors. Initiate research on procedures and techniques for maintenance training performance.

Program Element: #6.37.43.A
Title: Education and Training
DoD Mission Area: #552 - Environmental and Life Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

RDTE	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
Funds (Current Requirements)	7826	7105	8388	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	6178	8370	8623	Continuing	Not Applicable

Changes in FY 1979 reflect restructuring of this project element in 1979 in response to DoD guidance and changes in research sponsor priorities.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.37.43A
Title: Education and Training
DoD Mission Area: #552 - Environmental and Life Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Individual and unit training must be relevant, efficient and economical to ensure combat readiness. To achieve this, training research and development must be expanded to allow for performance evaluations in realistic field experiments. Prototype training/assessment materials include: (1) methods and materials to decentralize training; (2) tools to enable supervisors and commanders to be effective trainers and managers; (3) on-the-job refresher training and cross-training programs to enhance armor and aviator crew combat skills; (4) assessment measures for individuals and units;(5) methodology for predicting and increasing skill retention; (6) guidelines for preparation of Army training and evaluation program (ARTEPs) for infantry, air defense, and artillery units.

(U) RELATED ACTIVITIES: This program is coordinated with Air Force Program Element 6.37.51.F, Training and Education Innovations and with Navy Program Elements 6.37.20.N, Education and Training and 6.37.38.A, Non-Systems Training Device Development. Its products are coordinated with US Army Training and Doctrine Command and operational troop commands. Interservice coordination is effected through Tri-Service development, as well as Tri-Service Technical Advisory Group (TAG) in educational technology and training simulation; the objective of the TAGs is to exchange results and to eliminate duplication of effort by the military services in this area.

H. (U) WORK PERFORMED BY: Contractors include: Perceptronics, Inc., Woodland Hills, CA; Applied Science Associates, Valencia, PA; Applied Psychological Services, Inc., Wayne, PA; Litton Mellonics, Columbus, GA; McFann-Grey Associates, Monterey, CA; Kinton, Inc., Alexandria, VA. In-house work is performed by the US Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA, and its field units distributed at major installations, including Ft Benning, GA; Ft Bliss, TX; Ft Hood, TX; Ft Knox, KY; Ft Leavenworth, KS; Ft Ord, CA; Ft Rucker, AL; Ft Sill, OK; Ft Benjamin Harrison, IN; and Germany.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Designed and developed prototype training programs for gunnery/maintenance tasks in armor systems. Completed training effectiveness analysis for AN/TSQ-73 radar, which reduced training time by one-quarter. Developed and assisted in implementation of Army-wide self-paced instruction for nap-of-the-earth helicopter navigation, reducing errors by 33%. Developed improved rifle marksmanship procedures which reduced annual ammunition costs by 6.9 million dollars. Developed procedures for commanders to produce and use Skill Qualification Tests. Developed experimental individual and unit training techniques for the Army's new infantry fighting vehicle (IFV), for AN/TPQ-36 radar, Ground Laser Locator Designator, for AAH and BLACKHAWK helicopters. Developed experimental tank gunnery training methods which improved tank gunner performance by 24%.

Program Element: #6.37.43.A
Title: Education and Training
DOD Mission Area: #552 - Environmental and Life Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1980 Program: Collect data on motor skill decay rates and develop preliminary techniques for improving retention of procedural skills. Experimentally validate predictive models which enable unit commanders to predict when retraining is required. Develop procedures for providing training feedback to units training at the National Training Center. Conduct analysis to improve the state of the art of team training. Improve and evaluate training techniques for individual and crew infantry weapons such as TOW and DRAGON. Develop techniques for measuring effectiveness of training management programs. Develop improved procedures for maintenance training on Army vehicles.

FY 1981 Planned Program: Evaluate skill retention prediction models as used by unit commanders. Develop predictors of training effectiveness of videodisc and other exportable training methods. Conduct field test of alternative training management systems for infantry and field artillery batteries. Develop on-the-job training system for functional skills required for organizational maintenance training in armor units. Test and evaluate the training effectiveness of infantry fighting vehicle (IFV) Test and evaluate the training effectiveness of the Army maintenance training simulator (AMTESS).

4. (U) FY 1982 Planned Program: Integrate individual skill retention prediction model with team training and maintenance training requirements. Develop total tactical training program for National Training Center. Determine procedures for incorporating personnel and logistics requirements into training management. Evaluate infantry fighting vehicle/cavalry fighting vehicle (IFV/CFV) training procedures. Determine key common elements of artillery and air defense crew/team training, and develop predictors for crew/systems retraining.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.44.A Title: Training Simulation
DOD Mission Area: #552 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	983	1517	2353	Continuing	Not applicable
A795	Training Simulation	0	983	1517	2353	Continuing	Not applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Training simulation development involves the application of training technology to the development of simulators and training equipment for use in training and evaluating Army personnel. The mission need is to provide increased combat readiness in the face of decreasing resources in funds, equipment, ammunition and training areas.

C. (U) BASIS FOR FY 1981 REQUEST: Simulation methods have proven their utility in producing more effective and often less costly training. There is a continuing need to extend their application to additional systems and subsystems. Engagement simulation technology will be extended to air defense artillery training. Advanced computer technology will be incorporated into existing simulation systems; new armor systems, aviation systems and infantry systems coming into the inventory need parallel development in training devices and simulators. Engagement simulation technology will to be incorporated into the Army Training and Evaluation Program (ARTEP) and battle simulation and engagement simulation technologies will be integrated for the most effective use of the National Training Center.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE					
Funds (Current Requirements)	0	983	1517	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	1080	1065	1900	Continuing	Not Applicable

The decrease in FY 1981 reflects an Army decision to delay the development of the Armor Full Crew Research Simulator. The decrease in FY80 is due to a reduction by Congress. FY 79 funds were denied by Congress.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.37.44.A Title: Training Simulation
DoD Mission Area: #552 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program provides technology to develop or improve: current Army Training Evaluation Programs (ARTEP); procedures for evaluating tank crew and unit gunnery proficiency; collective tactical training; maintenance training; combat readiness while maintaining control of training costs; features of multi-media, multi-model flight training systems; development of improved Multiple Integrated Laser Engagement Simulation (MILES) training; technical support for the Project Manager for Training Devices (PM TRADE); and cost-effective training which better simulates conditions actually found on the job.

G. (U) RELATED ACTIVITIES: This research is coordinated with Army Training & Doctrine Command (TRADOC) Systems Manager for the National Training Center; TRADOC Combined Arms Training Developments Agency; Director of the Training Development US Armor School; US Army Training Support Center; Project Manager - Training Devices; US Air Force Human Resources Laboratory; TRADOC Systems Manager for XM-1 Tank; Naval Training Equipment Center; Army Aviation Center; Tri-Service/NASA Helicopter Research Coordination Panel; Army Materiel Development & Readiness Command (DARCOM); US Army Air Defense School; US Army Communicative Technology Office; and the 7th Army Training Command. The coordination accomplished by these actions is designed to eliminate duplication of efforts.

H. (U) WORK PERFORMED BY: Contractors include: Human Sciences Research, McLean, VA; Perceptronics, Woodland Hills, CA; American Institute for Research, Washington, DC; Human Resources Research Organization, Alexandria, VA; McDonnell Douglas Corporation, St. Louis, MO; Applied Sciences Associates, Huntsville, AL; Applied Psychological Services, Wayne, PA; WICAT, Inc., Salt Lake City, UT. In-house work is performed by the US Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA, and its field units distributed at major installations, including Ft Benning, GA; Ft Bliss, TX; Ft Hood, TX; Ft Knox, KY; Ft Ord, CA; Ft Benjamin Harrison, IN; Ft Rucker, AL; and Germany.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Components of the Army Training and Evaluation Program (ARTEP) have been redesigned to simulate tactical battlefield environments. A training circular entitled "How to Prepare and Conduct a Multiple Integrated Laser Engagement Simulation (MILES) Exercise" was prepared and fielded to include the MILES-based ARTEP for squad through company sized units. Analysis of BATTLE war game for company training resulted in simpler, more effective training. Reported data on critical display features and targets have been used to develop the new rifle marksmanship trainer. Methods developed for evaluating transferability of training in a CH 47 flight simulator and a AH1 Flight Simulator Instruction Guide which reduced pilot training time by 10 percent. Automated performance measurement for UH1 Flight Simulator improved the training in this simulator. A training devices concept/prototype (TRAINVICE) model was developed to aid in selection of appropriate training media. An automated performance-based objective grading system was developed for the UH1 Flight Simulator.

Program Element: #6.37.44.A Title: Training Simulation
DoD Mission Area: #552 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1980 Program: Revise the MILES based ARTEP and revise the training circular on "How to Prepare and Conduct a MILES Exercise" to reflect improvements in integrated engagement and battle simulation. An analyses of the training capabilities of XM-1 training devices will be completed. Work to determine the training implications of Armor thermal imaging systems will be undertaken. The automated grading system will be implemented on UH1 simulator. Use of simulators for aviation-applicant selection system will be validated. A proceduralized handbook for using the TRAINVICE model will be developed and field tested. Guidelines for preparing standards for developing training equipment and criteria for evaluating specifications and approaches in the development cycle will be prepared. Specification of the impact of critical command group performance requirements on battlefield outcomes will use the combined arms tactical training (CATTS) simulator. Measurement/evaluation techniques for platoon tank gunnery training in Europe and criteria for tank platoon training simulators will be developed.

3. (U) FY 1981 Planned Program: Continuation of engagement simulation development for indirect fire and for new weapons systems; development of the training and evaluation procedures and related devices at the National Training Center; development of small scale simulation exercises and devices for combat unit command training; improved training simulator packages for XM-1 tank and new Infantry and Cavalry Fighting Vehicles; training and simulation techniques for man-portable and new anti-tank missiles; generalized maintenance simulator development and evaluation; training device and simulation technique development and evaluation of air defense weapons; application of simulation techniques for improved aviator selection and assignment.

4. (U) FY 1982 Planned Program: Validate the maintenace training simulator. Applications of videodisc and voice technology for unit direct support and operator maintenance procedures in units will be tried out. Preparation of a behavioral science guide for simulation development is planned to reduce simulator development time and to place human performance criteria in engineering terms. Develop simulation techniques for selection and assignment. Continue support for National Training Center engagement simulation concepts.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.47.A
DOD Mission Area: #552 - Environment and Life Sciences (ATD)

Title: Soldier Support/Survivability
Budget Activity: #2 Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2685	2915	3462	3676	Continuing	Not Applicable
D610	Food Advance Development	473	545	1132	1357	Continuing	Not Applicable
D669	Clothing and Equipment	2212	2370	2330	2319	Continuing	Not Applicable

B. (U) 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. In addition to minimizing cost and logistic support requirements, there is a continuing need to guarantee 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: better cold and hot weather protective clothing; individual equipment for protection against noise attenuation, nuclear flash, chemical and biological agents; upgraded working conditions; and improved personal daily hygiene. New food processing techniques and feeding methods will ensure a responsive food system anywhere in the worldwide military mission areas outside the sphere of the Continental United States (CONUS) commercial food distribution system. Overall emphasis in food development is to reduce food service personnel requests, minimize food procurement cost, and reduce where possible logistic support requirements.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Items listed in this program are essential to improving the combat effectiveness of the soldier, fill gaps that exist in the soldiers' compatibility with new weapons 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. The food research requirements provide for advanced development of items of food and equipment for the Army, Navy, Air Force, Marine Corps, and Defense Logistics Agency; and constitutes a part of the Department of Defense (DOD) Food Research, Development, Testing, and Engineering (RDT&ERC) Program managed by the Army as executive agency.

Program Element: #6.37.47.A
DOD Mission Area: #552 - Environment and Life Sciences (ATD)

Title: Soldier Support/Survivability
Budget Activity: #2 Advanced Technology Development

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

RDTE	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
Funds (current requirements)	2685	2915	3462	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	2000	3415	6321	Continuing	Not Applicable

Increase in funding in D669, Clothing and Equipment in FY 1979 was to fully fund the combat vehicle crewman/artilleryman ballistic/noise attenuative helmet while also performing advance development (AD) on three other clothing and individual equipment programs. The decrease in current requirements for FY 1980 from that shown in the FY 1980 RDTE Congressional Descriptive Summary reflects a Congressional reduction for D610, Food Advance Development. For FY 1981, the reduction in the D610 program of food and equipment for military food service systems reflects reprogramming of funds to higher priority programs. New request represents a minimal program to bring needed items into AD phase. Some clothing and equipment programs have not progressed sufficiently in Exploratory Development to warrant initiation of AD.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.37.47.A
DOD Mission Area: #552 - Environment and Life Sciences (ATD)

Title: Soldier Support/Survivability
Budget Activity: #2 Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program element contains two soldier support-oriented projects which include food, clothing, and related personal and protective equipment for the individual soldier. A major effort, which started in FY 1979, will be the continuation of development of a ballistic/noise attenuation helmet for combat vehicle crewmen and artillerymen. Department of Defense (DOD) assigned 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 relative 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 Formulation Board comprised of representatives from all Services.

G. (U) RELATED ACTIVITIES: Each of the Military Services performs work to develop its Service-peculiar items of clothing and individual equipment. In order to preclude duplication of effort, close coordination is maintained through joint working groups, joint Service agreements and circulation of requirement documents; many of the items developed under this program are used by other Services. Work in clothing and individual equipment is also performed in Program Element (PE) 6.27.23.A, Clothing, Equipment, and Shelter Technology Project AH98, Clothing and Equipment Technology; and in PE 6.47.13.A, Combat Feeding, Clothing and Equipment, Project D140, Clothing and Equipment. Food research is a coordinated joint Services' effort and related work is conducted in PE 6.27.24.A, Food Technology; and PE 6.47.13.A, Combat Feeding, Clothing and Equipment, Project D548, Military Subsistence System. Basic research in support of both the food and clothing programs is done in PE 6.11.02.A, Defense Research Sciences, Project AH52, Research in Support Equipment of Individual Soldier Sciences.

H. (U) WORK PERFORMED BY: In-house work in this program is performed by the US Army Natick Research and Development Command, Natick, MA; US Army Human Engineering Laboratory, Aberdeen Proving Ground, MD; 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.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Advanced Development (AD) was completed on a cold-dry uniform (parka and trousers) and on water impermeable/vapor permeable rainwear. The Combat Vehicle Crewman (CVC) Clothing System was designed, fabricated, and transferred to Engineering Development. New footwear design concepts were investigated to improve foot safety, comfort and durability. Various materials were evaluated to determine insulation properties for petroleum, oil and lubrications (POL) handwear; biophysical studies were conducted on various prototype gloves to verify that the wearer could perform his

Program Element: #6.37.47.A
DOD Mission Area: #552 - Environment and Life Sciences (ATD)

Title: Soldier Support/Survivability
Budget Activity: #2 Advanced Technology Development

duties for six minutes at minus 50° Fahrenheit. Design contracts for a transportable helicopter enclosure were awarded. An "intensive" (hydroponic) agriculture unit was developed and is undergoing tests at the Naval Station, Argentia, Newfoundland. This unit produces fresh salad vegetables in a closed, controlled environment system on a continuous basis. All components of the continuous flow bakery are on hand or on contract to complete AD in FY80. Improvements to the M59 field range were completed. A new field oven was designed and tested for roasting and baking using the standard M-2 burner as the heat source.

2. (U) FY 1980 Program: Continue efforts on CVC/Artilleryman helmet initiated in FY 1979; complete the systems analysis and definition of medical design constraints. Initiate contracts for both helmet prototype fabrication and mold design validation. Evaluate prototype designs of ballistic eye protection and award contract for modified prototypes for Development Test 1. Initiate AD on micro-climate cooling system for use with chemical/biological (CB) clothing in armored combat vehicles. Complete AD of continuous flow bakery system for Army and US Marine Corps (USMC) and of helicopter enclosure. Complete AD of continuous flow bakery system for Army and US Marine Corps (USMC) and of military subsistence items for which there are no commericial equivalents. Continue AD of field food service equipment and of methods to control insect damage to subsistence in overseas warehouses for Defense Logistics Agency. Initiate AD of USMC field feeding equipment.

3. (U) FY 1981 Planned Program: Complete AD efforts in conjunction with CVC/Artilleryman helmet, hold a Validation In-Process Review (IPR) for approval to transition this item to Engineering Development. Conduct Development Test I/Operational Test 1 (DT 1/OT 1) on ballistic eye protection and on micro-climate cooling system for use with protective chemical-biological (CB) clothing items. Continue AD of field food service equipment to replace obsolescent Army, Air Force and Marine Corps equipment with particular emphasis on food service systems which complement and support the highly mobile weapon systems being introduced into the combat forces. Complete evaluation of the Navy's intensive agriculture unit. Initiate AD on Army field feeding system equipment for 1990's. Approximately one-half of the funds in the clothing and equipment program in FY 1980 and three-forths of the funds in FY 1981 are directed toward the CVC/Artilleryman helmet.

4. (U) FY 1982 Planned Program: Complete AD on micro-climate crew protective cooling system. Initiate AD on aircrew cold weather clothing systems (commercial and NATO items will be evaluated); lightweight, highly tactile CB gloves (conduct human factors and agent testing); heated handwear (conduct insulation studies of most promising concepts); and accessories/kits for use with modular general purpose tentage. Conduct field evaluation, physiological and human engineering studies of most promising commercial and foreign over-snow, mountaineering, and load-carrying equipment. Resume AD of footwear to evaluate prototype aircraft boots, modify as necessary and contract for design of verified prototypes. Initiate AD of US Air Force field feeding equipment. Continue AD of Army field feeding equipment for 1990's. Support Army hospital food service system implementation.

Program Element: #6.37.47.A
Title: Soldier Support/Survivability
DOD Mission Area: #552 - Environment and Life Sciences (ATD)
Budget Activity: #2 Advanced Technology Development

5. (U) Program to Completion: This is a continuous program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.48.A
Title: Advanced Development of Automatic Test Equipment and Systems
DOD Mission Area: #551 - Mobility and Logistics Technology Demonstrations
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	1400	9121	11756	Continuing	Not Applicable
	QUANTITIES						
AJ29	Automatic Test Support Systems (ATSS)	0	1400	8428	9797	Continuing	Not Applicable
D244	ATSS Language Util & Stand	0	0	693	1954	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element (PE) leads directly to production and fielding of test equipment by transferring today's automatic test equipment technology to production hardware to overcome logistics problems in the field caused by the complex electronic and optical systems in the XM1 tank, Fighting Vehicle System (FVS) combat vehicles, Advanced Attack Helicopter (AAH) aircraft, and the SINCGARS radio among others. These five systems will initially be fielded with expensive support systems in the form of highly trained repairmen, excessively large Automatic Test Equipment (ATE), or interim small-scale special purpose ATE. The objective of this PE is to replace large ATE with much smaller ATE and replace interim special purpose equipment with the fewest variations of type classified STANDARD test equipment. Two different ATE systems will be fielded to enable relatively low-skilled electronics technicians to troubleshoot and repair highly-sophisticated electronic and optical systems. One small-scale general purpose ATE system will be used by mechanics repairing electrical systems in the XM1 and FVS fighting vehicles. Another small-scale ATE will be used by missile system repairmen who go forward on the battlefield to make repairs. The third ATE will be shelter mounted/protected, and perform rear echelon repairs on electronic and electro-optical assemblies removed from the AAH, XM1, FVS, and SINCGARS systems, among many others. This PE also funds the Army coordination with the other Services in Joint undertakings under the sponsorship of the Joint Logistics Commanders (JLC), such as the Air Force MATE (ATE) program. Both the large and the small ATE's are required to reduce incorrect diagnosis and unnecessary repairs; reduce diagnostic time; reduce the variety of manual test equipment in the field; reduce provisioning requirements; and, most importantly to reduce the numbers of repair personnel. These efforts are the initial response to Army requirements for ATE at division level or even closer to the battle area. This PE includes vital complementary software efforts related to standard programming languages and software maintenance facilities.

Program Element: #6.37.48.A
Title: Advanced Development of Automatic Test Equipment and Systems
DOD Mission Area: #551 - Mobility and Logistics Technology Demonstrations
Budget Activity: #2 - Advanced Technology Development

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Award of one contract for which solicitation was conducted during FY80. This contract will initiate a three-year development effort resulting in the fielding of a shelter-mounted Directed Support Automatic Test Support System (DS ATSS) to include a manportable subset called the Automated Contract Support Set (ACSS). Production of the DS ATSS and the ACSS is scheduled for early FY84 and the first test sets will deploy to Europe to replace less effective interim test equipment supporting the XM2 combat vehicle. Subsequent production items will support the AAH combat aircraft system. Another contract will be continued to develop and field a manportable ATE, Simplified Test Equipment (STE-X), to be used by motor pool personnel repairing the engine and electrical systems in the XM1 and XM2 fighting vehicle systems. This general purpose vehicular test set will go into production in FY 1983.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	0	1400	9121	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	0	2000	9105	Continuing	Not Applicable

The increase in FY 1981 from previous request reflects adjustments due to inflation. The decrease in FY 1980 was due to Congressional committee action.

E. (U) OTHER APPROPRIATION FUNDS: ($ in thousands): Not Applicable.

Program Element: #6.37.48.A
DOD Mission Area: #551 - Mobility and Logistics Technology Demonstrations

Title: Advanced Development of Automatic Test Equipment and Systems
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: These efforts are the initial response to Army requirements for ATE at division level or even closer to the battle area. The first of such test sets was the Simplified Test Equipment - Internal Combustion Engines (STE-ICE) which provided the motor-pool engine repairman with ATE. This test set, fielded in FY 1979, is being expanded to cover the entire vehicular electrical systems on XM1, XM-2, and XM3 vehicles. This expansion is being partially funded by the vehicle development managers. Funds in this PE are provided for further application of this test set (to be called STE-X) so that all on-board electronic systems such as radios, night sights, etc., are included within its diagnostic capability and to facilitate ultimate use by the majority of the Army's vehicular fleet. Defective electrical/electronic assemblies such as receivers, transmitters, missile guidance systems, optics, fire control subassemblies, etc., when detected by STE-X or by other test equipment, are removed, sent to the rear for repair. This rear echelon maintenance facility, direct support, will be provided with the modular DS ATSS. The shelter-mounted DS ATSS will be specially configured for each commodity class. For example, the missile DS ATSS will include appropriate optical diagnostic/alignment capabilities. Subassemblies and printed circuit boards (PCB) that are identified as faulty by the DS ATSS are sent to the General Support (GS) where larger ATE Automatic Test Equipment Missile Support (ATEMS) and/or the AN/USM-410 have the powerful diagnostic capability required to identify defective piece parts (e.g., semiconductor devices) that need to be replaced so that the subassembly/PCB can be returned to stock. This PE funds development and fielding efforts for Simplified Test Equipment-Expanded (STE-X), Direct Support, Automatic Test Support System (DS ATSS), and Automatic Test Equipment Missile Support (ATEMS).

G. (U) RELATED ACTIVITIES: Program Element 6.27.79.A, Test Measurement and Diagnostic Technology and 6.47.46.A, Automatic Test Support Systems, accomplish the exploratory and engineering development work respectively. This effort is closely coordinated within the Army and with the Air Force Automatic Test program through participation in the Joint Logistic Commander's panel on automatic testing.

H. (U) WORK PERFORMED BY: In-house work is performed by the US Army Communications Research and Development Command, Ft Monmouth, NJ. Contractors are: Emerson Electric, St. Louis, MO; RCA Corporation, Burlington, MA; University of Pennsylvania, Philadelphia, PA; Ultrasystems, Irvine, CA. One contract to be awarded FY81 via a competitive bid.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Completed Operational Test (OT I) of concept of applying Automatic Test Equipment (ATE) at the General Support Field Maintenance Level. Provided intensive and continual technical support to Army Program Managers (PM's) in the integration of ATE into their systems. Convened a Special Task Force of representatives from

Program Element: #6.37.48.A
DOD Mission Area: #551 - Mobility and Logistics Technology Demonstrations

Title: Advanced Development of Automatic Test Equipment and Systems
Budget Activity: #2 - Advanced Technology Development

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 Task Force effort, the need for intensive, centralized management and augmented funding for ATE was validated, a Required Operational Capability (ROC) for the General Support Automatic Test Equipment was initiated, and the need for DS/ORG (direct support/organizational) type tester validated. Continued contractual effort to reduce test software development costs, and to determine the methods of implementing a Department of Defense (DOD) Standard automatic test equipment language. Complete efforts toward the definition of a Direct Support Automatic Test Support System (DS ATSS); convened an In-Process Review (IPR) seeking approval to enter accelerated development and acquisition in 1st Qtr FY81; continued to monitor ongoing Air Force General Support Type Automatic Test Equipment Development; continued work in the highly promising and important areas of automatic test program set generation and software transportability.

2. (U) FY 1980 Program: Solicit Advanced Development contract for the Direct Support Automatic Test Support Systems (DSATSS). Monitor the Air Force General Support (GS)-Level Type Automatic Test Equipment (ATE) Advanced Development Program and press initiatives in the areas of software utilization and standard language implementation. Participate in Joint Logistics Commanders (JLC) Panel on Automatic Testing assigned areas. Complete the establishment of the ATEMS testbed. Award the development contract for the general purpose vehicular ATE, STE-X.

3. (U) FY 1981 Planned Program: Award contract for development of hardware design and prototype fabrication DS ATSS. System software and prototype test program sets will be developed. Continue development contract for general purpose vehicular ATE, Simplified Test Equipment-Expanded (STE-X). Continue work leading to establishment of full transportability of ATE software and efficiency of test program set generation and continue JLC taskings in areas of ATE standards and tools.

4. (U) FY 1982 Planned Program: In FY 1982 the STE-X development will transition into production benefiting from system design input from Simplified Test Equipment Internal Combustion Engines (STE-ICE). Complete development of "suitcase" DS ATSS type tester.

5. (U) Program to Completion: The DS ATSS "suitcase" tester will transition into production capitalizing on advancements made by industry with microprocessing, configuration, and sizing of test equipment. This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #AJ29
Program Element: #6.37.48.A
Title: Automatic Test Support Systems (ATSS)
Title: Advanced Development of Automatic Test Equipment and Systems
DOD Mission Area: #551 - Mobility and Logistics Technology Demonstrations
Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This effort was the initial response to Army requirements for Automatic Test Equipment (ATE) at division level and forward to the battle area. A need exists within Army to develop a modular, portable general purpose automatic test equipment set which will allow forward area testing and either repair on site or evacuation to the more capable large-scale ATE now being procured and fielded. Without the small-scale ATE capability, the operational readiness of prime weapons systems such as Advanced Attack Helicopter (AAH), TOW Fighting Vehicle Systems, Single Channel Ground and Airborne Radio System (SINCGARS) will be significantly degraded. The alternative is to let each prime system develop its own unique test equipment resulting in greater costs, proliferation of different test sets, and unacceptable levels of nonoperational weapons systems. The first of such test sets was Simplified Test Equipment - Internal Combustion Engines (STE-ICE), which was fielded in FY 1979 to units in Europe. The STE-ICE program is being further expanded to cover the entire vehicular electrical systems in XM1, XM2 and XM3 vehicles and will be called STE-T (Transition). Further application of this diagnostic capability (STE-X) is being planned so that all on-board electronic systems will be tested, with the final intent of this program to have one test set to fault-isolate track and wheel vehicles.

B. (U) RELATED ACTIVITIES: Program Elements (PE's) 6.27.79.A (Test Measurement and Diagnostic Technology) and 6.47.46 (Automatic Test Support Systems), which accomplish the exploratory and engineering development work, respectively, are covered under this program.

C. (U) WORK PERFORMED BY: In-house work is performed by the United States (US) Army Communications Research and Development Command, Fort Monmouth, NJ; contractual efforts are provided by Emerson Electric, St. Louis, MO; RCA Corporation, Burlington, MA; University of Pennsylvania, Philadelphia, PA; Ultrasystems, Irvine, CA. One contract is to be awarded in FY 1981 via competitive bid.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS: Completed Operational Test (OT 1) of concept of applying Automatic Test Equipment (ATE) at the General Support Field Maintenance Level. Required Operational Capability (ROC) was initiated, and the need for a Direct Support/Organizational (DS/ORG) suitcase type tester was validated. Solicitation of Advanced Development Contract for DS tester will be made in FY 1980. Award contract for general purpose Vehicular Automatic Test Equipment STE-X. In FY 1981, award contract for hardware design and prototype fabrication of a DS suitcase tester. The STE-X tester will transition into production in FY 1982, and development of the "suitcase tester" will be completed. The suitcase tester will transition into production in FY 1983.

Project: #AJ29
Program Element: #6.37.48.A

Title: Automatic Test Support Systems (ATSS)
Title: Advanced Development of Automatic Test Equipment and Systems

DOD Mission Area: #551 - Mobility and Logistics Technology Demonstrations

Budget Activity: #2 - Advanced Technology Development

1. (U) FY 1979 and Prior Accomplishments: Convened a Special Task Force to determine the technical capabilities of industry in ATE and to determine ATE requirements of the Army. Task Force results identified a need for intensive centralized management, and augmented funding for ATE was validated. A Required Operational Capability (ROC) for the General Support Automatic Test Equipment was initiated. Definition of a Direct Support Automatic Test Support System (DS ATSS) was completed. Convened an In-Process Review (IPR) seeking approval to enter accelerated development and acquisition in 1st Qtr FY 1981 and continued to monitor ongoing Air Force General Support-type ATE development.

2. (U) FY 1980 Program: Solicit Advanced Development contract for the (DS ATSS). Complete the establishment of Automatic Test Equipment Missile Support testbed and award the development contract for the general purpose vehicular ATE, STE-X. Advanced Development contract solicitation for DS tester to industry has been released.

3. (U) FY 1981 Planned Program: Award contract for development of hardware design and prototype fabrication of a DS ATSS. Continue development contract for general purpose vehicular ATE, system software, and prototype test program sets will be developed for STE-X and DS tester.

4. (U) FY 1982 Planned Program: In FY 1982, the STE-X development will transition into production benefiting from systems design input from Simplified Test Equipment-Internal Combustion Engines (STE-ICE). Complete development of "suitcase" DS ATSS-type tests and begin lab and field tester, simulating anticipated environment.

5. (U) Program to Completion: The DS ATSS "suitcase type" tester will transition into production capitalizing on advancements made by industry with microprocessing configuration, sizing of test equipment, and test support philosophy.

6. (U) Major Milestones: Not Applicable.

Project: #AJ29
Program Element: #6.37.48.A

Title: Automatic Test Support Systems (ATSS)
Title: Advanced Development of Automatic Test Equipment and Systems
Budget Activity: #2 - Advanced Technology Development

DOD Mission Area: #551 - Mobility and Logistics Technology Demonstrations

7. (U) Resources ($ in thousands):

RDTE	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
Funds (current requirements)	0	1400	8428	9797	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	0	2300	8205	0	Continuing	Not Applicable
Quantities (current requirements)	Not Applicable.					
Quantities (as shown in FY 1980 submission)	Not Applicable					

The increase in FY 1981 from previous request reflects adjustment due to inflation. The decrease in FY 1980 from previous submission was due to Congressional committee action.

Other Appropriations: Not Applicable.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.49.A
Title: Technical Vulnerability Reduction
DOD Mission Area: #551 - Electronics and Physical Science
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1400	2600	2109	3065	Continuing	Not Applicable
D462	Technical Vulnerability Reduction	1400	2600	2109	3065	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is to provide a US Army Development and Readiness Command (DARCOM) focal point for improving and/or incorporating Counter-Countermeasures (CCM) capability in the development of Army systems based on known and projected enemy Countermeasures (CM) threats. Through performance of detailed technical analyses, evaluations, and studies, coordination and integration of various Department of Defense (DOD) agencies efforts to address CM/CCM, and presentation of findings to top-level management, this program ensures that CM threats and CCM alternatives are addressed early and throughout the life cycle of Army materiel systems. The program also strives to enhance the research and development (R&D) community's awareness of the CM threat and the necessity for early pursuit of appropriate CCM technology.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: Develop and combine chaff density distribution model and generic fuze model for evaluation of selected fuzes; continue work in CCM for battlefield lasers; investigate susceptibilities of initial synchronization schemes for Single-Channel Ground-Air Radio System (SINCGARS); explore CM/CCM trade-off benefits of millimeter (MM) Wave technology for developing systems; examine susceptibilities of selected intelligence, surveillance, and target acquisition (ISTA) systems and recommend CCM; develop CM/CCM "Spider charts"; develop extensive EW simulation for evaluation of communications/EW strategies which includes effects of terrain; continue work in Army signature program, radar systems vulnerability, multispectral screening, radar technology, and realistic battlefield parameters. Explore CM to fire-and-forget systems.

D. (U) BASIS FOR CHANGE BETWEEN FY 1981 and FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

Program Element: #6.37.49.A Title: Technical Vulnerability Reduction
DOD Mission Area: #551 - Electronics and Physical Science Budget Activity: #2 - Advanced Technology Development

	FY 1979	FY 1980	FY 1981	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1400	2600	2109	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	1500	2600	2975	Continuing	Not Applicable

Decrease in FY 1979 funds was reprogramming to meet higher priority requirement. Decrease in FY81 is due to budgetary constraints not anticipated in FY80.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.37.49.A Title: Technical Vulnerability Reduction
DOD Mission Area: #551 - Electronics and Physical Science Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to perform as the US Army Development and Readiness Command (DARCOM) countermeasure/counter-countermeasures (CM/CCM) focal point for ensuring that technical CM/CCM are properly evaluated and integrated with tactical and threat considerations by interfacing with the US Army Training and Doctrine Command (TRADOC) and the US Army Intelligence and Security Command (INSCOM), respectively, throughout the materiel acquisition process. The systems to be addressed are those involved in or relying upon the transmission, emission, reception, or reflection of signals by electromagnetic, sonic, seismic, chemical, or optical means. The office will review and integrate the CCM efforts of various DARCOM agencies to ensure coverage of critical systems and eliminate redundancy wherever possible. The technical aspects of CM/CCM will be directly handled by conducting studies of selected systems/developmental items, with the goal being the maintaining of the viability of US systems on the realistic battlefield.

G. (U) RELATED ACTIVITIES: Interaction among the Army's Intelligence, Doctrine, and Hardware Commands will assure that the newest technologies are combined with optimized tactics and up-to-date intelligence to provide effective and survivable battlefield weapons systems. This office, as the Development Communities counter-countermeasures (CCM) manager, will closely interface with vulnerability assessment activities, research and development laboratories, and product/project managers to preclude duplication of effort and make maximum use of existing capabilities. This will be performed by integration with the Office of Missile Electronic Warfare (OMEW) in its PE 6.37.18.A, Electronic Warfare (EW) Vulnerability (Vuln) and Susceptibility (Susc), Project D267, Missile Vuln/Susc; US Army Electronic Warfare Laboratory (EWL) in its PE 6.37.18.A, EW Vuln and Susc, Project D626, Non-Missile Vuln/Susc; US Army Missile Command (MIRCOM) in its PE 6.37.18.A, EW Vuln and Susc, Project D235, Missile CCM Technology, and the Office of the Test Director (OTD) in its PE 6.37.18.A, EW Vuln and Susc, Project D190, Tri-Service Electro-Optic Weapons Vuln/Susc.

H. (U) WORK PERFORMED BY: Work is performed by the DARCOM CM/CCM Office located at the US Army Electronics Research and Development Command, Adelphi, MD.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: This project began as a continuation of the SAM-D Missile Vulnerability Studies Office. In September 1977, this office was chartered by the Army's Materiel Development and Readiness Command and its mission expanded to act as DARCOM's focal point for CM/CCM actions. The Office analyzed the effects of standoff jammer (SOJ) and self-screening jammer (SSJ) on the performance of the PATRIOT missile radar against low-altitude targets. Published plan to manage test of electro-optical (EO) systems in battlefield aerosols and investigated Tri-Service Thermal Suppression activities for the Office of the Secretary of Defense (OSD). Chaired joint working groups for integrating onboard protection systems for armored vehicles, and for investigating near millimeter wave propagation in smoke/chaff. Co-sponsored and

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participated in signature acquisition foreign exploitation-OCONUS Program (SAFE-OP). Funded US Army Night Vision and Electro-Optical Laboratory (NV&EOL) effort to upgrade signature data banks. Provided input to Smoke Week II tests and helped Program Manager for Smoke evaluate limited visibility problems. Provided membership to Smoke Aerosol Steering Group for development of DARCOM tech base program for smoke-related research. Performed operational security risk assessments of the FIREFINDER radar system. Did independent assessments of the PATRIOT missile, the remotely piloted vehicle (RPV), advanced attack helicopter (AAH), and XM1. Completed studies in communications warfare. Initiated effort to develop realistic battlefield standards in response to Vice Chief of Staff, Army tasking. Developed draft handbook to integrate CM/CCM into the materiel acquisition process. Developed CM portion of COPPERHEAD cost and operational effectiveness analysis (COEA). Assessed impact of electronic warfare (EW) and electro-optical (EO) countermeasures (CM) on COPPERHEAD, and published plan for the assessment of laser threat to US EO equipment. Studied effects of chaff on PATRIOT and threat of multispectral screening technology to US equipment. Provided US Army Electronics Research and Development Command (ERADCOM) support to Multispectral Screening Steering Group. Prioritized technical threats to Surveillance Target Acquisition Radar for Tank Location and Engagement (STARTLE) system, and initiated program to counter highest priority threats. Analyzed susceptibilities of various frequency hop rates and modulations to jamming and electomagnetic interference (EMI). Initiated study of US surveillance capability versus Soviet emitters.

2. (U) FY 1980 Program: Initiate development of computer model for dynamic chaff dipole density distribution as a function of dispersal and environmental parameters and combine with generic fuze model. Evaluate laser threat to EO systems and effectiveness of repeaters and jammers against laser-guided weapons; initiate actions to protect US systems with specific work on AAH/Target Acquisition Designator System (TADS)/HELLFIRE; contribute to HELLFIRE COEA. Examine synchronization time of SINCGARS candidates as functions of jamming. Investigate new hardening techniques for battlefield computers. Identify and quantify CM/CCM trade-offs of various mm-wave techniques for selected ERADCOM and US Army Armament Research and Development Comillimeter and (ARRADCOM) Programs. Examine Guardrail V, TACFIRE, TSQ-73, QUICKLOOK, and other selected ISTA systems for CM susceptibility and identify CCM. Publish CM/CCM "How To Do Book." Develop model that incorporates EW and terrain effects on communications systems. Continue signature program. Perform technical assessments of Division Air Defense System (DIVADS) and PATRIOT and support Harry Diamond Laboratory (HDL) and Signal Warfare Laboratories (SWL) programs in antiradiation weapons and antiradiation missile (ARM) CM. Analyze performance and effect of CM on most promising fire-and-forget concepts. Extend multispectral screening impact assessments to US Air Defense Artillery (ADA) systems and maintain threat/technology overview. Identify potential CM susceptibilities of selected conceptual radar programs. Publish definitions for realistic battlefield standards and develop programs to gather/reduce data.

3. (U) FY 1981 Planned Program: Extend fuze/chaff model to ROLAND and DIVAD Gun. Ensure Battlefield Environment Laser Designator Weapon System Simulation (BE-LDWSS) capability to model laser jammers and repeaters. Assess effect of laser

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jammer/repeater/spoofer on laser-guided weapons. Investigate means to minimize interference between SINCGARS and other information links to decrease their susceptibility to jamming. Examine susceptibilities of major command, control and communication (C^3) links from Intelligence, Surveillance, and Target Acquisition (ISTA) systems to All-Source Analysis System (ASAS) and potential advantages to new techniques for front-end processing, such as use of microprocessors at source. Define/optimize CCM/system parameters to maximize Surveillance and Target Acquisition Radar For Tank Location and Engagement (STARTLE) survivability; identify benefits of millimeter-wave technology for low probability of intercept, multistatic, holographic, and target imaging radar techniques. Examine CM susceptibility of AN/TSQ-112 (TACELIS), AN/TSQ-109 (AGTELIS), and other selected ISTA systems and identify CCM. Classify capabilities/gaps in EO and visual ISTA arena. Incorporate spread spectrum devices into simulations. Continue to fill new signature data requirements. Influence CCM-related test issues and review result of Standoff Target Acquisition System (SOTAS) operational test (OT) II; evaluate vulnerabilities of SOTAS and PERSHING II for respective COEA's. Study state-of-the-art in advanced sensor technology for fire-and-forget systems. Continue multispectral screening threat definition/impact assessment. Review selected technology base areas (Coherent Imaging/Radar/Holography/etc.) for potential application to Combat Surveillance, Target Acquisition and Fire Control Radars.

4. (U) FY 1982 Planned Program: Incorporate new chaff concepts into chaff/fuze model. Update lethal laser threat/recommend system "fixes." Develop Field test to measure interference between SINCGARS/other systems. Investigate susceptibility of information fusion and display processes at All-Source Analysis System (ASAS) to jamming/false information insertion. Continue CM/CCM efforts on STARTLE. Utilize EW/Communications model to determine effectiveness of ISTA systems. Identify capabilities/gaps in magnetic, EMI, and acoustic signature areas. Incorporate millimeters wave, optics, and effect of smoke/rain/dust into the simulation. Continue signature collection effort. Review projected response threats for radar systems in early stages of development. Continue study of advanced technology for fire-and-forget systems. Apply multispectral screening threat data to evaluation of proposed US responses. Review tech base areas of Foliage Penetration Radar System (FOPEN) and advanced ground surveillance radar technology.

5. (U) Program to Completion: This is a continuing program.

FY 1981 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.50.A
Title: Drug & Vaccine Development
DoD Mission Area: #552 - Environmental and Life Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

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

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1000	2545	5140	5939	Continuing	Not Applicable
A808	Drug & Vaccine Development	1000	2545	5140	5939	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: *Infectious diseases* have historically had major impacts on military operations through the reduction of personnel available to field commanders. The ability to prevent or treat diseases depends upon the capability to produce pilot lots of vaccines and/or drugs and to conduct appropriate field testing prior to final fielding of the items. Since diseases that are of concern to the military are not of general civilian public health importance in the United States, commercial production base for such vaccines or drugs does not exist; no civilian agency is prepared to conduct large-scale field trials. The requirement exists to maintain limited pilot lot production with commercial scale-up translational ability to meet DoD contingency requirements and to conduct necessary field trials prior to type classification/stockage of such items.

C. (U) BASIS FOR FY 1981 RDTE REQUEST: The logical progression in the development of drugs and vaccines effective for preventing and treating militarily important infectious diseases requires pre-clinical and clinical evaluation in humans. This program effectively fulfills this requirement. It is the essential final step in development of drugs and vaccines to be stocked and used within the DoD system.

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D. (U) BASIS FOR CHANGE BETWEEN FY 1981 AND FY 1980 CONGRESSIONAL DESCRIPTIVE SUMMARIES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1000	2545	5140	Continuing	Not Applicable
Funds (as shown in FY 1980 submission)	1000	2550	3623	Continuing	Not Applicable

The increase in funds for FY 81 is essential to establish the mechanism for expanding production technology to provide for initial human safety and efficacy testing (Phase I) and evaluation of products by comprehensive field trials (Phase II - IV). Increased funding will result in attainment of the following goals: (i) comprehensive field trials of new antimalarial drugs, (ii) complete field testing of an antileishmanial drug, (iii) complete Phase II testing of killed TC-83 VEE vaccine and apply for FDA licensure. FY80 reduction is the result of a general congressional reduction.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

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F. (U) DETAILED BACKGROUND AND DESCRIPTION: The military community has a continuing requirement for safe and effective drugs and vaccines to protect soldiers against endemic and epidemic diseases which decrement training, mobilization, or combat operations. In the interest of national security, military personnel must be prepared to engage in combat in any geopolitical region. Therefore, to assure strategic mobility, drugs and vaccines must be available to protect against diseases encountered should contingency plans be activated. This program focuses on essential advanced developmental studies for preventive and curative drugs and vaccines used by military personnel. These products must be effective against parasitic, bacterial, rickettsial, and viral diseases. Candidate drugs and vaccines thus developed must undergo necessary advanced pharmacologic and toxicologic evaluations required by the Food and Drug Administration, Bureau of Biologics, and Department of Defense. These prophylactic and therapeutic products are then tested under natural conditions in large-scale field trials prior to stocking in the DoD system.

G. (U) RELATED ACTIVITIES: Related Army studies are performed under Program Element 6.11.02.A, Defense Research Sciences, and Program Element 6.27.70.A, Military Disease Hazards Technology. Complementary infectious disease research conducted by the Navy, National Institutes of Health, Department of Agriculture, and the Center for Disease Control is pertinent to this program element. However, the Army drug and vaccine development program does not duplicate these efforts as it focuses on preventing or treating militarily important diseases which cause morbidity or mortality of troops in training, mobilization, or combat operations. Army representation on Department of Defense coordinating committees and other intergovernmental agency coordination councils assures coordination at the working and administrative levels to prevent duplication of effort. Army scientists serve as consultants with the World Health Organization and have access to this organization's studies, reports, and publications. Other coordination is accomplished by personal contacts at the operating level, by site visits by project officers, organization of technical 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 resumes.

H. (U) WORK PERFORMED BY: Approximately 55% of the research will be conducted by the in-house laboratories of the Walter Reed Army Institute of Research, Washington, DC; the US Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD; and field units in Thailand, Kenya, and Brazil. The remaining work is conducted by extramural contracts awarded to the Salk Institute, San Diego, CA; BioMed, Inc., Washington, DC; and the University of Hawaii, Honolulu, HI.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1979 and Prior Accomplishments: Completed human toxicity and safety testing (Phase I clinical trials) of Mefloquine, a newly developed antimalarial drug, and continued Phase I testing of standard antileishmanial drugs. Mefloquine demonstrated nearly complete protection in larger numbers of volunteers (Phase II, clinical studies) when administered weekly or fortnightly. As a direct result of meningococcal vaccines A & C, developed by the US Army Medical Research and Development

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Command, morbidity and mortality rates of meningitis in recruit centers have been reduced by over 90%. Successfully completed Phase I testing of meningococcal vaccines B, Y, and W135 types. Effectiveness of adenovirus type 4 and 7 vaccines, developed by the USAMRDC, were monitored and shown successful in recruit training centers. Continued long-term testing of volunteers (Phase II) with the killed Venezuelan equine encephalitis (VEE) vaccine (TC-83). Initiated Phase I studies on dengue 2 vaccine in volunteers. Initiated a Phase I clinical study of a prototype vaccine consisting of E. coli pili. Produced six large lots of Rift Valley fever (RVF) vaccines. Initiated Phase I testing of a new experimental RVF vaccine in volunteers. Prepared RVF test antigens for use in diagnosis of the disease. Prepared certified cells for use as vaccine substrates for laboratories within USAMRDC. Gathered and processed first lots of high-titer human antiserum for protection from toxin producing organisms (viz: botulinum).

2. (U) FY 1980 Program: Continue Phase II testing of antimalarial drug, Mefloquine. Initiate Phase I clinical trials of alternatives to Mefloquine for the treatment of malaria. Continue Phase I testing of standard antileishmanial drugs. Prepare pilot lots and initiate Phase II clinical trials of meningococcal vaccines. Complete advanced development of adenovirus types 4 and 7 vaccines pending licensure by FDA. Continue Phase II studies with killed VEE vaccine. Continue Phase I testing of dengue 2 vaccine. Continue testing of E. coli pili vaccine. Continue Phase I testing in volunteers of Rift Valley fever vaccine. Initiate Phase I testing for an improved Q fever vaccine developed for protecting troops exposed to this potential BW agent. Continue gathering and processing high-titered antisera to toxin producing organisms. Initiate testing of candidate insect repellents under field conditions for improved effectiveness and durability in providing personal protection to the soldier, especially during highly mobile combat operations.

3. (U) FY 1981 Planned Program: Continue Phase II clinical trials of Mefloquine and Phase I testing of alternative drugs for treatment of malaria. Complete Phase I testing of standard antileishmanial drugs and initiate Phase II testing; initiate Phase I testing of experimental antileishmanial drugs. Continue Phase II clinical trials of meningitis vaccines. Complete Phase II testing of killed TC-83 VEE vaccine and apply for FDA licensure. Initiate Phase I studies with new TC-84 VEE vaccine. Complete Phase I clinical trials of dengue 2, Rift Valley fever, and E. coli pili vaccines and prepare reports. Continue Phase I testing of Q fever vaccine. Initiate Phase I testing of individual toxoids for use as a prophylaxis against botulinum poisoning. Evaluate newer repellents under natural insect and environmental conditions for efficacy in preventing vector-borne diseases. Maintain pilot-lot scale-up vaccine capability. Personnel to be utilized: 3 professional and 5 support.

4. (U) FY 1982 Planned Program: Complete Phase II studies of Mefloquine and write report; continue Phase I testing of alternative drugs for treatment of malaria. Continue Phase II testing with standard antileishmanial drugs; continue Phase I clinical trials of experimental antileishmanial drugs. Initiate clinical trials of antipenetration drugs for schistosomiasis. Complete Phase II meningitis vaccine field trials and write report. Continue Phase I testing with attenuated TC-84 VEE vaccine. Prepare pilot lots and initiate Phase II clinical studies with dengue 2 vaccine; initiate Phase I testing of vaccines effective against dengue serotypes 1, 3 and 4. Prepare pilot lots and initiate Phase II testing of RVF and E. coli vaccines. Complete

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Phase I studies with Q fever vaccine and write report. Continue Phase I testing of toxoids as prophylaxis against botulinum poisoning. Participate in Phase III testing of commercially available hepatitis B vaccine. Initiate Phase I testing of a vaccine against African trypanosomiasis. Test insect repellent products for safety and efficacy in pesticide impregnated fatigue uniforms. Maintain rapid-response capability for industrial scale-up for vaccines and drugs of military interest.

5. (U) Program to Completion: This is a continuing program.

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